GuardShield™ Micro 400 Safety Light Curtains User Manual

Allen-Bradley

GuardMaster®

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in the guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Rockwell Automation sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequences.
SHOCK HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.

It is recommended that you save this user manual for future use.

Conditions required for proper use of the GuardShield Micro 400 Safety Light Curtain

Please make sure you read and understand these requirements before you select and install the GuardShield Micro 400 safety light curtain. GuardShield safety light curtains are point of operation and perimeter access safeguarding devices. These safety light curtains are intended to be used to to provide point of operation and perimeter access safeguarding of personnel on a variety of machinery.

The GuardShield Micro 400 family of safety light curtains are general purpose presence sensing devices which are designed to protect personnel working on or near machinery.

The installation of GuardShield Micro 400 safety light curtains must comply with all applicable federal, state, and local rules, regulations, and codes.

It is the responsibility of the employer to properly install, operate and maintain the product as well as the machinery on which the GuardShield Micro 400 presence sensing device is installed.

GuardShield Micro 400 safety light curtains must be properly installed by qualified personnel.

GuardShield Micro 400 safety light curtains are presence sensing devices and will not protect personnel from heat, chemicals, or flying parts. They are intended to signal a stop of hazardous machine motion when the sensing field is broken.

GuardShield Micro 400 safety light curtains can only be used on machinery which can be stopped anywhere in its stroke or cycle.

GuardShield Micro 400 safety light curtains should never be used on full revolution clutched machinery.

The effectiveness of the GuardShield Micro 400 safety light curtains depends upon the integrity of the machine control circuit. The machinery on which the GuardShield Micro 400 presence sensing device is installed should have control circuitry that is fail safe in design.

All stopping mechanisms for the machinery should be inspected regularly to ensure proper operation. The protected machinery must have a consistent reliable and repeatable stopping time.

ATTENTION	Failure to read and follow these instructions can lead to misapplication or misuse of the GuardShield Micro 400 safety light curtains, resulting in personal injury and damage to equipment.

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This manual covers the operation and installation of the:

- GuardShield Micro 400 POC,
- GuardShield Micro 400 IP69K systems, and
- GuardShield Micro 400 special configurations in the appendix

IMPORTANT	Save these instructions for use at a future time.

Generally recognized technical regulations and quality assurance system ISO 9000 are carefully applied during the development and production of Allen-Bradley/ Guardmaster products.

This technical description must be followed when installing and commissioning the GuardShield Micro 400. Inspection and commissioning must be carried out by a qualified person.

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Introduction

The GuardShield Micro 400 is an economical three box (transmitter, receiver and controller) Type 4 safety light curtain offered in a small profile (15 x 20 mm (0.59 x 0.79 in.)) housing.

The protective heights are offered from 150...1200 mm in 150 mm increments. The compact housing size allows the GuardShield Micro 400 to be mounted in areas where standard safety light curtains may not be able to be mounted due to space constraints. It is also possible to recess the GuardShield Micro 400 transmitter and receiver into machine frames.

Micro 400 System

The Micro 400 requires a dedicated controller, either an MSR41 which has ON/OFF functionality or an MSR42 which offers advanced functionality of fixed and floating blanking, manual restart and muting. The MSR42 can also be used as a multi function safety module, allowing the connection of additional safety light curtains, safety laser scanner — any safety device with PNP type outputs.

The Micro 400 transmitter and receiver are offered with 8-pin M12 connectors at the end of 500 mm (20 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are the same part number and are offered in a variety of lengths. These patchcords are configured on one end with M12 connectors which mate to the integrated pigtail connectors and RJ45 connectors on the opposite end which plug into to the MSR 41 or MSR42 controllers.

Micro 400 Cascading

The GuardShield Micro 400 is also offered in a "cascadeable" configuration. GuardShield Cascadeable Micro 400 safety light curtains allow the interconnection of multiple segments of the Micro 400 safety light curtain with a common pair of safety outputs. This cascadeable configurability of the GuardShield Micro 400 reduces overall system wiring and allows the GuardShield Micro 400 to be fitted into a variety of applications where the safety distances for mounting the light curtain may allow personnel to stand between the light curtain's sensing field and the hazard or where multiple-sided guarding is required and the use of corner mirrors is not possible.

A GuardShield Cascadeable Micro 400 safety light curtain system is comprised of one or two pair of Cascadeable Micro 400 light curtains as well as a standard Micro 400 pair as the last segment pair in the cascaded system.

GuardShield Micro 400 cascaded pairs are offered in both 14 mm and 30 mm resolutions in limited protected heights. It is possible to mix 14 mm and 30 mm resolution pairs in a Cascaded Micro 400 system.

Note: The standard GuardShield Micro 400 must always be the last segment in a Cascaded Micro 400 system

A cascadeable pair of GuardShield Micro 400 light curtains has a 500 mm (20 in.) pigtail with a female M12 quick disconnect on the bottom of the Micro 400 light curtain and a 500 mm (20 in.) pigtail with a male M12 quick disconnect attached to the top of the Micro 400 transmitter and receiver.

The GuardShield Cascadeable Micro 400 system operates as a single light curtain pair with a common set of OSSDs. Each segment pair is connected in series making the complete system's response time the sum of each segment pair, plus the response time of the MSR41 or MSR42 and other safety devices in the stop circuit.

When connecting two cascadeable segments together, the resultant cable length between segments is 1000 mm (40 in.).

If an additional length between segment pairs is required, Rockwell offers an M12 to M12 patchcord in 1, 3, and 5 m (3.3, 9.8, and 16.3 ft) lengths (445L-AC8PC1 or 445L-AC8PC3).

Note: The maximum Cascaded Micro 400 system length can not exceed 10 m (32.8 ft) as measured between the RJ45 connection at the MSR 41 or MSR 42 Controller to the last beam in the standard Micro 400, including all cable lengths. The maximum number of beams in a cascaded Micro 400 system can not exceed 255 beams.

Micro 400 Washdown Option

The GuardShield Micro 400 is offered with the transmitter and receiver sealed in clear polycarbonate tubes with an environmental rating of IP69K. These IP69K Micro 400 light curtains are factory sealed and are ordered as pairs. They are offered in a 14 mm resolution in protected heights of 300, 600, 900, and 1200 mm (11.8, 23.6, 35.4, and 47.2 in.).

The required MSR41 or MSR42 controllers maintain the IP20 rating and must be mounted in a suitable enclosure.

The Micro 400 IP69K transmitter and receiver are both offered with 8-pin M12 connectors at the end of 500 mm (20 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are the same part number and are offered in 3, 5, and 8m (9.8, 16.4, and 26.2 ft) lengths.

These patchcords are configured on one end with M12 connectors which mate to the integrated pigtail connectors and RJ45 connectors on the opposite end which plug into to the MSR42 or MSR41 controller.

Micro 400 Specials

In addition to the standard GuardShield Micro 400 configurations, the GuardShield Micro 400 is also offered in special configurations as described in the Appendix.

The GuardShield Micro 400 family of safety light curtains are general purpose presence sensing devices, designed for use on hazardous machinery providing point of operation (POC), as well as, perimeter (PAC) detection.

IMPORTANT	These installation instructions are designed to address the technical personnel of the machine manufacturer and or the installer of the safety system regarding the proper mounting, configuration, electrical installation, commissioning, operation and maintenance of the GuardShield Micro 400 safety light curtain. These installation instructions do not provide instruction for the operation of machinery to which the GuardShield Micro 400 safety light curtain is, or will be, integrated. Only qualified personnel should install this equipment.

Important Requirements

The GuardShield Micro 400 requires a dedicated controller. The MSR41 controller is used for on/off applications and the MSR42 can also be used as a multi-functional safety module, allowing the connection of additional safety light curtains, safety laser scanner, or any safety device with two Output Signal Switch Devices (OSSD) outputs, or two contacts, such as E-Stops and enabling switches.

There are a number of operating modes that can be configured with the MSR42 controller. EDM, Start/Restart interlock, fixed and floating blanking and muting are possible.

Safety Precautions

Principles for Safe Use and Symbols Used

The following instructions are preventive warnings to ensure the safe and proper operation of the GuardShield Micro 400 light curtains. These instructions are an essential part of the safety precautions and therefore have to be observed at any time.

Throughout this manual we use the labels ATTENTION and IMPORTANT to alert you to the following:

ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequences.

ATTENTION helps you

- Identify a hazard
- Avoid a hazard
- Recognize the consequences

IMPORTANT: Identifies information that is especially important for successful application and understanding of the product.

IMPORTANT	Identifies information that is critical for successful appilcation and understanding of the product.

ATTENTION	The GuardShield Micro 400 must not be used with machines that cannot be stopped electrically in an emergency. The safety distance between the GuardShield Micro 400 and a dangerous machine movement has to be maintained at all times.

Additional mechanical protective devices have to be installed in a way that hazardous machine elements cannot be reached without passing through the protective field.

The GuardShield Micro 400 has to be installed in a way that operators can only access the hazard through the sensing field of the Micro 400.

Improper installation can result in serious injury.

Never connect the outputs to +24V DC. If the outputs are connected to +24V DC, they are in ON-state and cannot stop hazardous spots at the machine/application.

Never expose the GuardShield Micro 400 to flammable or explosive gases.

Specialist Personnel

The GuardShield Micro 400 safety light curtain must be installed, commissioned and serviced only by a qualified person. A qualified person is defined as a person who:

- Has undergone the appropriate technical training

and

- Who has been instructed by the responsible machine operator in the operation of the machine and the currently valid safety guidelines

and

- Who has read and has ongoing access to these installation instructions

Range of Uses of the Device

The GuardShield Micro 400 safety light curtain is classified as electro-sensitive protective equipment (ESPE). It fulfills the requirements of a Type 4 ESPE defined by IEC 61496-1 and CLC/TS 61496-2 and is, therefore, allowed for use with controls in safety category Type 4 in compliance with EN ISO 13849, SIL CL3 in accordance with EN62061 or up to PLe in accordance with EN ISO 13849.

These devices are suitable for:

- Point of operation protection (finger and hand protection)
- Hazardous area protection

Access to the hazardous point must be allowed only through the protective field. The machine/system is not allowed to start as long as personnel are within the hazardous area. Refer to the "Examples of Range of Use" on page 6 for an illustration of the protection modes.

Depending on the application, mechanical protection devices may be required in addition to the safety light curtain.

POC:

The physical resolution of the GuardShield Micro 400 POC is

- 14 mm (0.55 in.) or
- 30 mm (1.18 in.).

The protective field height of standard GuardShield Micro 400 is between 150 mm (5.91 in.) and 1200 mm (47.2 in.).

The maximum protective field width is 0...5 m (16.4 ft).

Cascadable Micro 400

The physical resolution of cascadable GuardShield Micro 400 POC is

- 14 mm (0.55 in.) or
- 30 mm (1.18 in.).

The protective field height of cascadable GuardShield Micro 400 is between 300 mm (11.82 in.) and 1200 mm (47.2 in.). The maximum protective field width is 0...5 m (16.4 ft).

Micro 400 IP69K Option

The physical resolution of the GuardShield Micro 400 IP69K is 14 mm (0.55 in.). The protective field height of GuardShield Micro 400 IP69K is between 300 mm (11.8 in.) and 1200 mm (47.2 in.). The maximum protective field width is 0...5 m (16.4 ft).

The Micro 400 IP69K option has the Micro 400 light curtains factory sealed in polycarbonate enclosures.

The GuardShield Micro 400 require a controller to operate in conjunction with one of the following safety controllers

- MSR41 ON/OFF functionality
- MSR42 multi-function module

Proper Use

The GuardShield Micro 400 safety light curtain must be used only as defined in the "Range of Uses of the Device." It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified personnel.

If the device is used for any other purposes or modified in any way, warranty claims against Allen-Bradley/Guardmaster shall become null and void.

General Protective Notes and Protective Measures

IMPORTANT	**Safety Notes** Please observe the following items in order to ensure the proper and safe use of the GuardShield Micro 400 safety light curtain.

The national/international rules and regulations apply to the installation, use and periodic technical inspections of the safety light curtain, in particular:

- Machine Directive 2006/42/EC
- Low Voltage Directive 2006/95/EC
- Use of Work Directive (2009/104/EC)
- The work safety regulations/safety rules
- Other relevant health and safety regulations

Manufacturers and users of the machine with which the safety light curtain is used are responsible for obtaining and observing all applicable safety regulations and rules.

- The notices, in particular the test regulations of these installation instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.
- The tests must be carried out by specialist personnel or specially qualified and authorized personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- The installation instructions must be made available to the user of the machine where the GuardShield Micro 400 safety light curtain is installed. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the installation instructions.

Product Description

This section provides information on the special features and properties of the safety light curtain. It describes the structure and functions of the unit, in particular the different operating modes.

Please read this section before mounting, installing and commissioning the unit.

Special Features

- Slim design 15 x 20 mm (0.59 x 0.79 in.)
- Built in diagnostic LEDs
- HW configurable with MSR41
- HW and SW configurable with MSR42
- M12 connector on 20 inch pigtails
- Maintenance free and cost effective

Principle of Operation

The GuardShield Micro 400 safety light curtain consists of a non-matched pair of optic units, i.e., transmitter and receiver with the same protected height and resolution. The controller functionality of the Micro 400 light curtains are through a separate control module.

- MSR41 ON/OFF functionality
- MSR42 multi-function module

The maximum distance between transmitter and receiver is referred to as the protective field width or range. The protective field height is the distance between the first and last beam in the device.

The transmitter emits sequential pulses of infrared light which are received by the GuardShield Micro 400 receiver and processed by the connected controller. The synchronization of the timing of the emission and reception of infrared light pulses is accomplished by the connected MSR controller.

The connected controller has safety outputs [Output Signal Switching Devices (OSSDs)] and nonsafety auxiliary outputs. When the GuardShield Micro 400 transmitter and receiver are properly connected and aligned, the OSSDs of the connected controller are current sourcing

+24V DC. Interruption of the sensing field causes the controller to switch the sourced current OFF (0V DC).

Restoring the GuardShield Micro 400 sensing field, (in Guard only configuration) causes all safety outputs (OSSDs) of the connected controller to switch to the active high state (resume current sourcing +24V DC).

IMPORTANT	Operating mode as manual or automatic restart (reset), EDM (external device monitoring), blanked beams or overriding of the GuardShield Micro 400 are controlled from the connected safety controller (e.g. MSR42). For details see user manual of the connected safety controller.

The GuardShield Light Curtain

The GuardShield Micro 400 safety light curtain consists of a transmitter and a receiver.

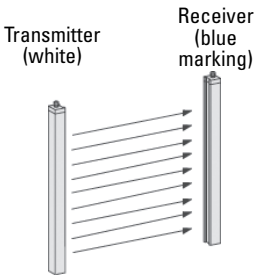


Figure 1: Components of the GuardShield Micro 400

The protective field is between the bottom of the top end cap and the area above the status LEDs.

The width of the protective field is derived from the length of the light path between transmitter and receiver and must not exceed the maximum rated width of the protective field 0...5 m (0...16.4 ft).

Cascading

The GuardShield, Micro 400 POC is also available in cascading segments which allow a number of GuardShield Micro 400 transmitters and receivers to be interconnected. This product configurability allows the GuardShield Micro 400 to protect multiple sides of a machine or simply adds flexibility when positioning the GuardShield Micro 400 in various applications.

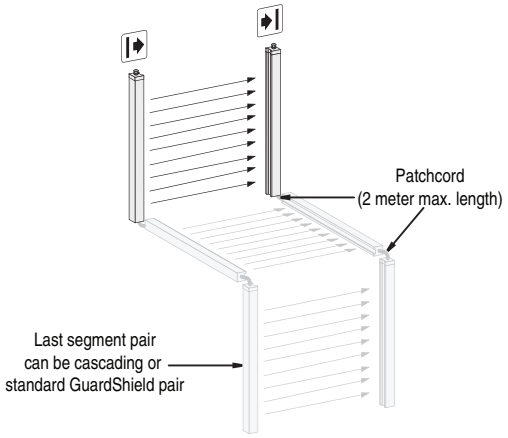


Figure 2: Up to three GuardShield Micro 400 segments can be interconnected

Standard GuardShield Micro 400 cascading segments are offered in protective heights from 300...1200 mm in both 14 mm and 30 mm resolutions.

A maximum of three GuardShield Micro 400 light curtains can be interconnected (maximum two cascades plus one standard GuardShield Micro 400). The maximum number of beams in a cascading system is 255 beams. The individual segments can have mixed resolutions, i.e., 14 mm and 30 mm as long as the pairs have the same protective heights and resolutions. The maximum cable length from the control unit to the last beam can be 10 m.

Cascading segments cannot be used as standalone light curtain pairs.

However, if using multiple cascaded pairs or only one, the last pair in the cascaded system must be a standard GuardShield Micro 400 light curtain.

The following limitations need to be considered:

- A maximum of 255 light beams per controller
- 10 m maximum total length for light curtains, extension modules and connection cable combined (Figure 14)
- Only a Rockwell patchcord (445L-AC8xxx) may be used between the light curtains and the controller. A patchcord is required to connect the M12 connector of the Micro 400 to either the MSR41 or MSR42 controller. The patchcord has an 8-pin M12 on one end and an RJ45 connector on opposite end.

Examples of Range of Use

The GuardShield Micro 400 safety light curtain operates as a proper protective device only if the following conditions are met:

- The control of the machine must be electrical.
- The controlled machine must be able to be stopped any where in the machines stroke or cycle.
- The transmitter and receiver must be mounted such that access to the hazard is only through the light curtain's protective field.
- If used as an access device, the restart button must be located outside the hazardous area such that it can not be operated by a person working inside the hazardous area.
- The statutory and local rules and regulations must be observed when installing and using the device.

IMPORTANT	Additional measures may be necessary to ensure that the ESPE does not fail to danger when other forms of light radiation are present in a particular application (i.e., use of cableless control devices on cranes, radiation from weld spatter or effects from strobe lights).

Safety Functions

The GuardShield Micro 400 safety light curtain offers a variety of functions, which are integral to the system.

Operating modes, functions and features of the GuardShield system are activated through HW or SW of the corresponding connected MSR41 or MSR42 controller. For details, please refer to the manual of the attached controller.

IMPORTANT	The protective system must be tested for proper operation after each and every change to the configuration.

Response Time

The standard response time of the light curtain (see MSR42) is dependant on the physical resolution and the protective height and is shown on the product label. The actual response time depends on the connected control unit and its configuration. The response time may be faster and can be taken from the corresponding configuration control document, created from the configuration software of the corresponding safety controller (e.g., MSR42).

The total light curtain response time for cascaded light curtains is the sum of the response times of each cascade. The declared response times are worst case values.

A worst case response time is printed on the product label. e.g.:

19 ms Response time t_{LC} of the light curtain cascade

MSR42 Response time of the control unit including any connected MSR45 relay modules

t_N Sum of response times t_{LC} of all additional connected GuardShield Micro 400 light curtain cascades

Example of the total response time of a cascaded light curtain:

Description	Length/Resolution	Response time ($t_{LC} + t_C + t_N$)
Cascade 1	1200/14 mm	41.9 ms + t_C + t_N
Cascade 2	300/14 mm	18.5 ms + t_C + t_N
Cascade 3	600/14 mm	26.3 ms + t_C + t_N
System	1200/14-300/14-600/14 mm	88.7 ms + t_C

Table 1:

The response time printed on the product label reflects the double scan mode of the MSR41 and MSR42 controller.

IMPORTANT	The response time of the GuardShield Micro 400 light curtain system is dependent on the operating mode of the connected safety controller. With the help of an optical interface (445L-AF6150) it is also possible, to delay the response time of the connected safety light curtain system, when the GuardShield Micro 400 is connected to the MSR42 controller. If a controller unit is reconfigured, a new configuration control document must be printed and has to be kept close to the controller. Also the corresponding control unit has to be marked with the provided label.

A detailed explanation, including the corresponding safety information, for configuring a MSR42 controller module may be found in the "Configuration Tool" program manual.

Parameters which may lead to an increased response time:

- Stop delay time
- Blanking
- Muting
- Using an MSR45E relay expansion module

IMPORTANT	When making changes to the configuration of the GuardShield Micro 400 system, it is necessary to recalculate the safety distance and potentially relocate the GuardShield Micro 400 light curtains at the proper distance from the hazard.

Blanking

There are some industrial applications where material must be fed through the protective field (e.g., textile machines or small assembly machines). This movement of material through the GuardShield Micro 400's sensing field in the standard safety mode would result in an interruption and therefore bring the machine to an unwanted stop. To avoid this it is possible to blank out certain beams. This operating mode is generally known as "Fixed Blanking." Blanking functionality is available with the MSR42 controller and requires the optical interface module to program this functionality.

IMPORTANT	The device can be operated in a fixed and/or floating blanking mode if an MSR42 controller is used. The resolution will increase according configuration control document. The light curtain stick has to be clearly labeled with the configured resolution.

With a MSR42 safety controller and an Optical Interface (445L-AF6150) it is possible for authorized personnel to activate different blanking modes. Blanking modes are broken down into the following categories:

- Fixed blanking
- Floating blanking

IMPORTANT	With the blanking function, the resolution and the response time of the GuardShield Micro 400 light curtain system will be changed. If the "Blanking" function is activated, a new, longer response time and a new, larger resolution will be present, which must be applied to the calculation of the safety distance. The minimal safety distance of the light curtain must always be adapted to the actual operating mode. The corresponding reaction time of a light curtain without blanking is stated on the label of each system. If blanking is configured, the new reaction time, and the new resolution, according to the configuration control document must be entered in the appropriate spaces on the supplied label, and attached to the GuardShield Micro 400 light curtain (see Figure 3). The labels are provided with the GuardShield Micro 400 mounting kit.

Fixed blanking	From beam.....to beam.....
Floating blanking	Resolution.....mm
Reduced resolution	Reaction time.....ms

Figure 3: Additional label for blanking. After configuring blanking, the label must be attached and clearly visible on the receiver portion of the light curtain

IMPORTANT	Further information on "Blanking" may be found in the “Configuration and Diagnostic Tool” manual for the corresponding safety controller (e.g. MSR42).

Determining the Safety Distance

The light curtain must be mounted with proper safety distance

- From the point of danger
- From reflecting surfaces

US Safety Distance Formula

IMPORTANT	The GuardShield Micro 400 safety light curtains must be mounted at a sufficient distance from the pinch point or point of operation hazard to ensure that the machine stops before a person’s finger, hand, arm(s), or body reaches the hazard.

This distance, referred to as the safety distance, must be properly calculated prior to determining the safety light curtain’s protective height and mounting the light curtains on the machine. Failure to properly calculate this safety distance may result in operator injury.

IMPORTANT	Regardless of the calculated safety distance, GuardShield Micro 400 safety light curtains should never be mounted closer than six inches from the point of operation or pinch point hazard.

In the United States there are two formulas that are used to properly calculate the safety distance. The first, the OSHA formula, is the minimum requirement for the calculation of the safety distance. The second formula, the one recommended by Rockwell Automation, is the ANSI formula, which incorporates additional factors to be considered when calculating the safety distance.

OSHA Safety Distance Calculation Formula

The OSHA safety distance formula as specified in CFR Subpart O 1910.217 is as follows:

$$Ds = 63 \times T_S$$

Ds Safety Distance in inches

63 Is the OSHA recommended hand speed constant in inches per second

Ts Is the total stop time of all devices in the safety circuit, measured in seconds. This value must include all components involved in stopping the hazardous motion of the machinery. For a mechanical power press it is the stopping time measured at approximately the 90° position of the crankshaft rotation.

Note: The T_S number must include the response times of *all* devices, including the response time of the safety light curtain, the safety light curtain controller (if used), the machine’s control circuit and any other devices that react to stop the hazardous motion of the machinery. Not including the response time of a device or devices in the stop time calculation will result in insufficient safety distance for the application. This may result in operator injury.

IMPORTANT	Determining Stop Time: The measurement of stopping time (Ts) must include the stopping times of all devices in the stop circuit. Not including all device and control system elements when calculating Ts will result in an inaccurate safety distance calculation.

The ANSI Safety Distance Formula

The ANSI safety distance formula, which is the Rockwell Automation recommended formula, is as follows:

$$D_S = K \times (T_S + T_{CS} + T_r + T_{bm}) + D_{pf}$$

Ds Minimum safety distance between the safeguarding device and the nearest point of operation hazard, in inches.

K Hand speed constant in inches per second. The ANSI standard value is 63 inches per second when the operator begins reaching toward the point of operation hazard from rest. NOTE: ANSI B11.19 1990 E4.2.3.3.5 states “The value of the hand speed constant, K, has been determined by various studies and although these studies indicate speeds of 63 inches/second to over 100 inches/second, they are not conclusive determinations. The employer should consider all factors, including the physical ability of the operator, when determining the value of K to be used.”

Ts Stop time of the machine tool measured at the final control element.

Tcs Response time of the control system.

Note: T_s and T_{cs} are usually measured by a stop time measuring device.

Tr Response time of the presence sensing device (safety light curtain) and its interface (MSR4x and MSR45E). This value is generally stated by the device manufacturer or it can be measured by the user.

Tbm Additional time allowed for the brake monitor to compensate for variations in normal stopping time.

Dpf Depth penetration factor. It is an added distance to allow for how far into the protective field an object, such as a finger or hand, can travel before being detected. D_{pf} is related to the safety light curtain's object sensitivity. Object sensitivity is the smallest diameter object which will always be detected anywhere in the sensing field.

Example:

In opto-electronic safeguarding, such as with a perpendicular safety light curtain applications with object sensitivity (effective resolution) less than 2.5 inches, the D_{pf} can be approximated based on the following formula:

D_{pf} (inches) = 3.4 × (Object Sensitivity – 0.276),
but not less than 0.

European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger. This safety distance ensures that the point of danger can only be reached after the dangerous state of the machine has been completely removed.

The safety distance as defined in EN ISO 13855 and EN ISO 13857 depends on:

- Stopping/run-down time of the machine or system. (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the protective device, e.g. GuardShield Micro 400 (for "Response Time" see page 7).
- Reach or approach speed.
- Resolution of the light curtain and/or beam separation.

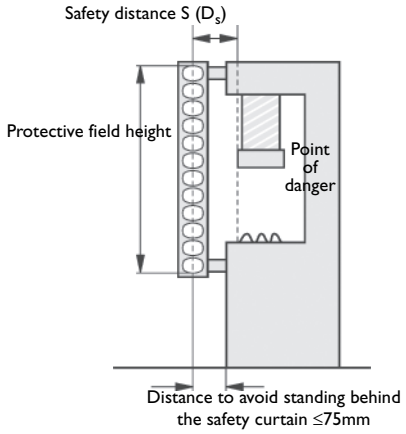

Safety distance S (Ds)
Protective field height
Point of danger
Distance to avoid standing behind the safety curtain ≤75mm

Figure 4: Safety distance from the point of danger

How to Calculate the Safety Distance S According to EN ISO 13855 and EN ISO 13857:

-> First, calculate S using the following formula:
S = 2000 × T + 8 × (d – 14) [mm]

Where...

T = stopping/run-down time of the machine + response time of the protective device [s]
d = resolution of the light curtain [mm]
S = safety distance [mm]
The reach/approach speed is already included in the formula.

-> If the result S is <= 500 mm (19.6 in.), then use the determined value as the safety distance.

-> If the result S is > 500 mm (19.6 in.), then recalculate S as follows:
S = 1600 × T + 8 × (d – 14) [mm]

Example:

Stopping/run-down time of the machine = 290 ms
Response time = 30 ms
Resolution of the light curtain = 14 mm (0.55 in.)
T = 290 ms + 30 ms = 320 ms = 0.32 s
S = 2000 × 0.32 + 8 × (14 – 14) = 640 mm (25.1 in.)
S > 500 mm (19.6 in.) therefore:
S = 1600 × 0.32 + 8 × (14 – 14) = 512 mm (20.1 in.)

Minimum Distance from Reflecting Surfaces

The infrared light from the transmitter may be reflected off of shiny surfaces and be received by the system's receiver. If this condition occurs, it can result in an object not being detected when it enters the GuardShield Micro 400 sensing field.

All reflecting surfaces and objects (e.g. material bins) must therefore be located at a minimum distance *a* from the protective field of the system. The minimum distance *a* depends on the distance *D* between transmitter and receiver.

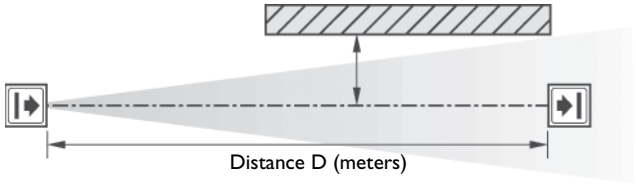


Figure 5: Minimum distance from reflecting surfaces

How to Determine the Minimum Distance from the Reflecting Surfaces:

-> Determine the distance *D* [m] transmitter-receiver

-> Read the minimum distance *a* [mm] from the graph:

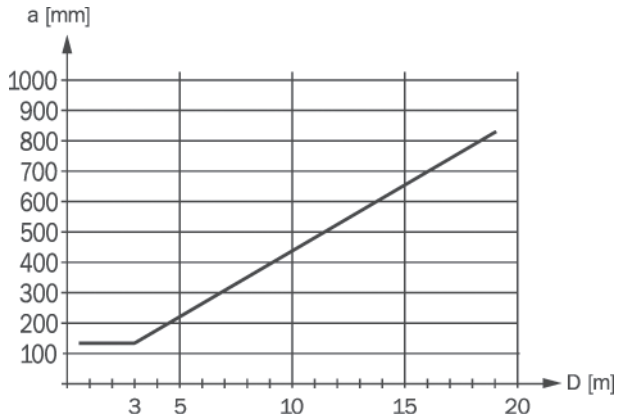


Figure 6: Graph, minimum distance from reflecting surfaces

The effective aperture angle for the GuardShield Micro 400 system is ± 2.5° at a mounting distance of > 3.0 m (9.8 ft). Calculate the minimum distance to reflecting surfaces depending on the distance between the transmitter and the receiver, using an aperture angle of ± 2.5°, or take the appropriate value from the following table:

Distance Between Transmitter and Receiver (Range D) [m (ft)]	Minimum Distance a [mm (in.)]
0.2…3.0 m (0.65…9.8 ft)	135 (5.31)
4.0 m (13.1 ft)	175 (6.88)
5.0 m (16.4 ft)	220 (8.66)

Table 2: Table, minimum distance from reflecting surfaces

Formula: a = tan 2.5° x D [mm]

a = minimum distance to reflecting surfaces
D = distance between transmitter and receiver

Installation and Mounting

This section describes the installation of the GuardShield Micro 400 safety light curtain.

A rigid and flat base, isolated against shock and vibration should be selected to mount the GuardShield Micro 400 light curtain. This in combination with the standard mounting bracket set will keep the initial alignment during operation even in harsh industrial environments.

The GuardShield Micro 400 safety light curtain is suitable for most benign operating environments (IP54). Proper safety distance as well as adequate protective height must be observed. For the installation height and safety distance, please refer to "Determining the Safety Distance" section on page 8.

IMPORTANT	The installation of the GuardShield Micro 400 safety light curtain must be such that access to the hazard is only possible through the sensing field of the GuardShield. Auxiliary safeguarding may be required in conjunction with the GuardShield Micro 400 to meet this requirement.

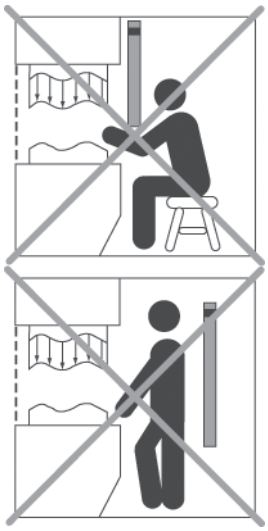
Determine if the machinery, on which the GuardShield Micro 400 is to be mounted, meets the requirements as specified in the beginning of this manual, i.e., machinery must be able to be stopped anywhere in its stroke or cycle, consistently and repeatedly.

Correct Installation

Operators cannot reach hazardous machine parts without passing through the protective field.

Operators must not step between the protective field and hazardous machine parts (by-pass prevention).

Incorrect Installation



Operators can reach hazardous machine parts without passing through the protective field.

Operators can step between the protective field and hazardous machine parts.

The GuardShield Micro 400 must be mounted at the proper distance from the point of operation hazard. This distance is referred to as the Safety Distance.

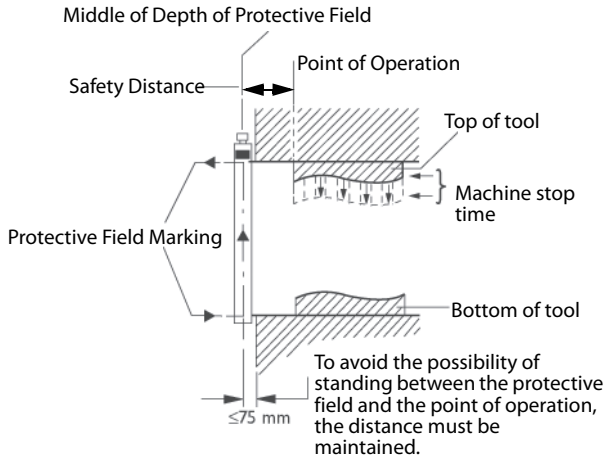

Middle of Depth of Protective Field
Point of Operation
Safety Distance
Top of tool
Machine stop time
Protective Field Marking
Bottom of tool
To avoid the possibility of standing between the protective field and the point of operation, the distance must be maintained.
≤75 mm

Figure 7: Determining machine stopping time and safety distance

Installation and Alignment Procedure

Standard GuardShield Micro 400

The alignment procedure can be made easier with the use of integrated indicator LEDs *(Table 1)*.

1. Mount the transmitter and receiver with the brackets (Figure 9). Make sure that the longitudinal axis of both are oriented parallel to each other. For a vertical or horizontal mounting a level might help to find the correct position.
2. Take care that the receiver and transmitter are oriented in the same direction. This means, the beginning of the protective field which is found next to the cable which leads to the safety controller, must be located at the same end of the protective field. A reference would be that the indicator LEDs are opposite one another. It is not allowed to mount the GuardShield Micro 400 systems rotated 180° (Figure 8: Layout of the transmitter/receiver).
3. Connect the transmitter and receiver to the controller and power up according the description in the following section. The indicators will help for alignment.
4. After aligning the longitudinal axis of the transmitter and receiver, rotate the receiver along the longitudinal axis to find the receiving angle. During rotation, the receiving angle is shown by the illumination of the green LED in the GuardShield Micro 400 light curtain. If this green LED is blinking, the amount of light detected by the receiver is not sufficient for stable operation. After realigning the light curtain, the protective field must be briefly interrupted. After removing the object from the protective field, a sufficient intensity level is indicated by the illumination of the green LED in the light curtain.
5. Adjust and mount the receiver at the center of this operating angle.
6. After aligning the receiver, rotate the transmitter to find the transmitting angle. During rotation, the transmitting angle is shown by the illumination of the green LED in the GuardShield Micro 400 light curtain.
7. Adjust and mount the transmitter at the center of this operating angle.
8. Test the protective function of the GuardShield Micro 400 light curtain by using the test rod, according to Figure 13. The insertion of this rod into the protective field at any position has to lead to a protective field interruption (illumination of the red LED in the GuardShield Micro 400).

Cycle power to assure that the system powers up and goes to the ON state.

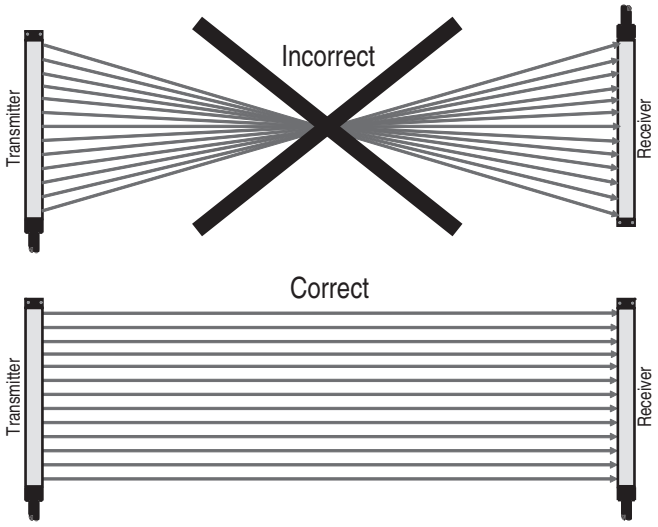


Figure 8: Layout of the transmitter/receiver

Multiple GuardShield Micro 400

When two or more GuardShield Micro 400s are mounted in close proximity to one another, it may be possible for the receiver of one GuardShield Micro 400 pair to receive infrared light from the transmitter of another GuardShield Micro 400 pair.

There are various techniques to prevent or eliminate the possibility of optical interference from light curtains mounted in the same plane. The simplest method is to alternate transmitter and receiver pairs so that the receiver from a second pair is facing away from the transmitter of another light curtain pair in close proximity. It is also possible to place a physical barrier between pairs to prevent the infrared light from reaching another light curtain pair.

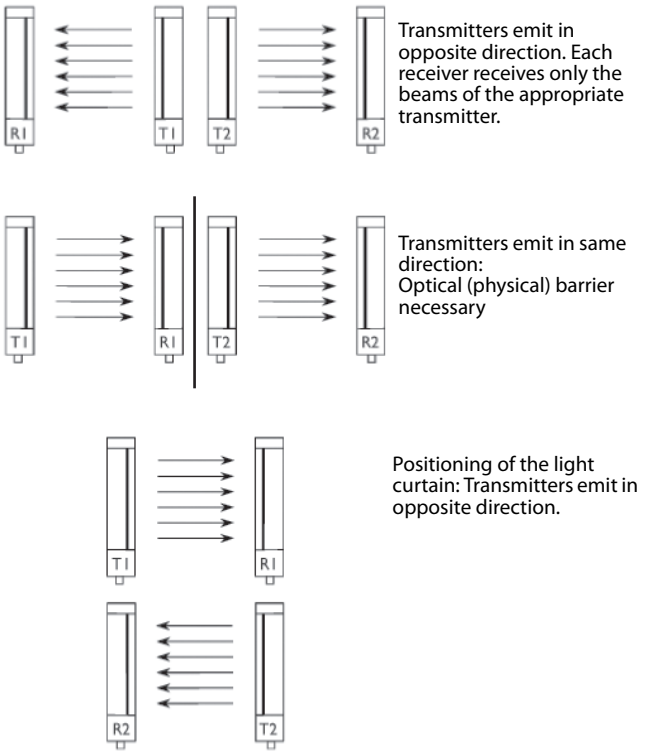


Figure 9: Multiple GuardShield Micro 400 alignment options

Cascaded GuardShield Micro 400

Configuration of Operating Modes in Cascading Systems

All of the operating modes of a cascaded GuardShield Micro 400 can be configured at the MSR42 control unit.

Two Segment Cascading GuardShield Systems

When the safety distance calculation requires that a GuardShield pair is vertically mounted at a distance that would allow a person to stand between the vertical pair and the machine hazard, a means of detection of that person is required.

There are a few methods of detecting the presence of a person who could be standing in front of the machine hazard but inside of the light curtain; installing a safety mat or safety laser scanner are possible solutions, however, they are costly solutions as these are separate safety systems that need to be integrated to the safety circuit. The most cost-effective solution is to interconnect an additional light curtain in series to the vertical pair. This is accomplished by first selecting a cascading pair of GuardShield Micro 400 safety light curtains with a protective height and resolution based upon the results of a risk assessment. It is then necessary to select the horizontal protected height of the pair of GuardShield Micro 400 light curtains. This pair should provide detection from the vertical pair to the front of the machine hazard. In most cases this pair of GuardShield Micro 400 can be 30 mm resolution as their purpose is to detect the presence of a person, not a person's fingers or hands.

The next step is to select the interconnect patchcords for the transmitter and receiver. These patchcords are offered in a variety of lengths ("Table 6: Available cable types" on page 14). The final cascading segment which is not connected to another pair of GuardShield Micro 400 light curtains is equal to a standard GuardShield Micro 400 light curtain.

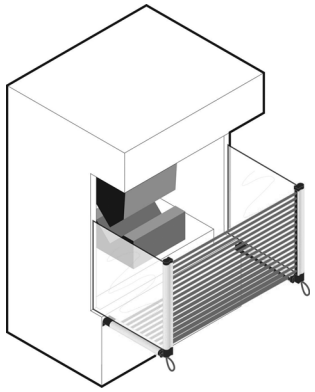


Figure 10: "L-shaped" two segment GuardShield Micro 400 cascading systems offer protection when it is possible to stand between the vertical light curtain and the machine hazard

Three Segment GuardShield Cascading Systems

When the use of corner mirrors is not practical or possible, three-sided guarding of a machine hazard is possible using cascading GuardShield Micro 400 light curtains.

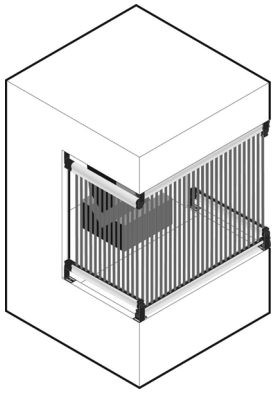


Figure 11: Top and bottom mounting of three GuardShield Micro 400 segments is possible, which will provide three-sided machine guarding without the use of corner mirrors

Mounting and Alignment of Cascading GuardShield

IMPORTANT	It helps to align the cascading segments in a particular order. First connect the last segment (segment with one connector) closest to the control unit. Once the LED in the edge is green; secure mounting brackets of that pair. Next connect middle segment to the last segment and connect to the controller. When middle segment receiver LED is green secure those brackets. Finally connect the closest segment to the other segments and connect all together to the controller. Only the diagnosis LED of the first segment displays the protective field status. The LEDs of other segments stay off. For aligning a cascaded system, the optical interface module (see "Accessories" on page 24) can be a valuable alignment help.

In a cascading system only the LEDs of the segment closest to the controller are working. LEDs of other segments don't work.

Micro 400 IP69K

The GuardShield Micro 400 IP69K meets the requirements of Protection Classes IP65, IP66, IP67, IP68 and IP69K to IEC 60529 standards.

The tubes surrounding the GuardShield Micro 400 have no influence on either operation range or safety class as per IEC/EN 61496-1.

Mounting kits are provided which attach to the connection and end module of the tube. The Micro 400 IP69K is supplied with the two mounting brackets. Do not rotate end or connection cap (danger of bending the light curtain).

The polycarbonate enclosure must be cleaned regularly and when dirty.

1. Do not use any powerful cleansing materials.
2. Do not use any abrasive cleansing materials.
3. Due to static charge dust particles remain attached to the polycarbonate enclosure. You can alleviate this effect by using an antistatic plastic cleansing agent applied with an antistatic cloth for cleaning.
4. Clean polycarbonate enclosure as follows:
   - Remove dirt on the enclosure using ample quantities of water. In that way you will avoid scratching the surface.
   - Then wipe off with a clean, slightly damp cloth.
   - Finally, dry the plastic tube with a clean cloth.

After every cleaning process please note the following:

- Remove water residues on the enclosure.
- Wipe the tubes with a clean cloth.
- Check position of transmitter and receiver to ensure that excessively loose or excessively tight grip or movement to the back by the safety device is not possible.
- Check safety function of the protective device

The connection plug has to be mounted away from high pressure water.

Protection Class (IEC 60529)		
Tube:		IP65, IP67, IP69K
Plug:		IP65
Material:	Connector and closure caps	POM (Polyoxymethylene)
	Plastic tube	PC (Polycarbonate)
	Cable screw fitting	PA6 (Polyamide 6)
	O-Rings (seals)	NBR (Nitril-Butadien-Rubber)
	Mounting brackets	V2A [1.4301 (X5CrNi18-10)]

Table 3: Material specification

Mounting Brackets

The GuardShield Micro 400 is mounted using brackets which attach to the side of both transmitter and receiver. It may be necessary to use additional brackets to mount the GuardShield Micro 400 at a proper safety distance from the machinery hazard. The backside of the light curtain profile has continuous grooves to fix the mounting brackets at any position along the light curtain housing.

Further brackets may be obtained as an option, to offer the possibility of mounting on the side or in the center:

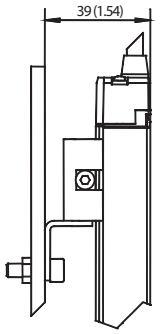
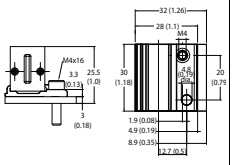
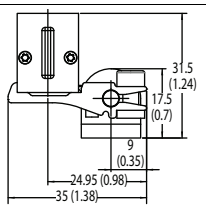
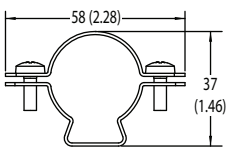
		445L-AF6143 Adjustable 180° bracket kit (two per kit) supplied with each pair
		445L-AF6145 Flat bracket kit (two per kit) Two kits required per pair
		445L-AF6149 Adjustable flat bracket (two per kit) Two kits required per pair
		445L-AF6160 IP69K mounting bracket kit (two kits per pair supplied with each pair)

Table 4

Electrical Installation

Connections

The connection of a GuardShield Micro 400 to a machine controller must occur using an MSR41 or MSR42 Series safety controller module. Only prefabricated cable (445L-AC8xxx) provided by Rockwell Automation may be used between the light curtain and controller (Table 5).

The Micro 400 requires two patchcords, one for the transmitter and one for the receiver. The M12 8-pin connector is used for connecting to the light curtain, while the RJ45 connector is plugged to the controller. M12 to M12 patchcords are used for extending the cable, especially between cascades of the Micro 400 light curtain.

The connection cables are offered with color coded rings attached to each cable. Remove one color ring from the cable as necessary. The following color code is defined:

White – Transmitter (Tx)

Blue – Receiver (Rx)

Description	Cat. No.
Patchcord, PVC jacket, 1 m M12 to RJ45	445L-AC8RJ1
Patchcord, PVC jacket, 2 m M12 to RJ45	445L-AC8RJ2
Patchcord, PVC jacket, 3 m M12 to RJ45	445L-AC8RJ3
Patchcord, PVC jacket, 5 m M12 to RJ45	445L-AC8RJ5
Patchcord, PVC jacket, 8 m M12 to RJ45	445L-AC8RJ8
Patchcord, PVC jacket, 1 m M12 to M12	445L-AC8PC1
Patchcord, PVC jacket, 3 m M12 to M12	445L-AC8PC3
Patchcord, PVC jacket, 5 m M12 to M12	445L-AC8PC5

Table 6: Available cable types

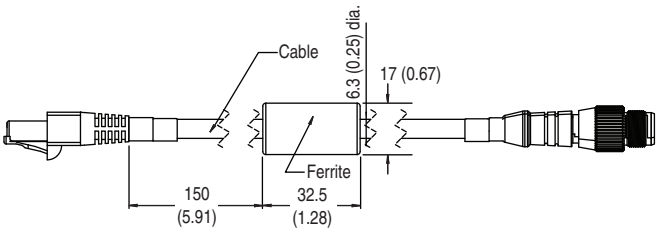


Figure 12: RJ45 connector 8-pin connector [shielded cable], connection cable from MSR41 or MSR42 control unit to the light curtain

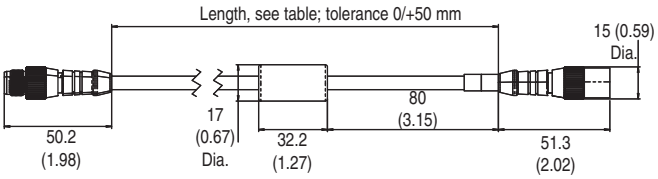


Figure 13: M12 connector (male) M12 8-pin connector (female) [shielded cable]

Patchcord M12 to M12 to extend connection cable or to use between light curtain cascades.

Electrical Installation

The connection of a GuardShield Micro 400 to a machine controller must occur using an MSR41 or a MSR42 Series safety controller module. Power supply, inputs, safety outputs and status outputs are connected to the terminal block of the MSR41, MSR42 controller or a MSR45E.

The interfacing of the light curtain with the machine control has to be control reliable, i.e. a correct interface with a safety PLC or safety relays with positive guided relay contacts.

ATTENTION	The safety devices and the interconnection to the machinery have to comply with the basic safety requirements as mentioned in the current regulations and standards. Direct interfacing of a safety light curtain to machine control that does not meet the necessary safety integrity level, i.e., use of general purpose PLCs or general purpose relays may result in injury to personnel.

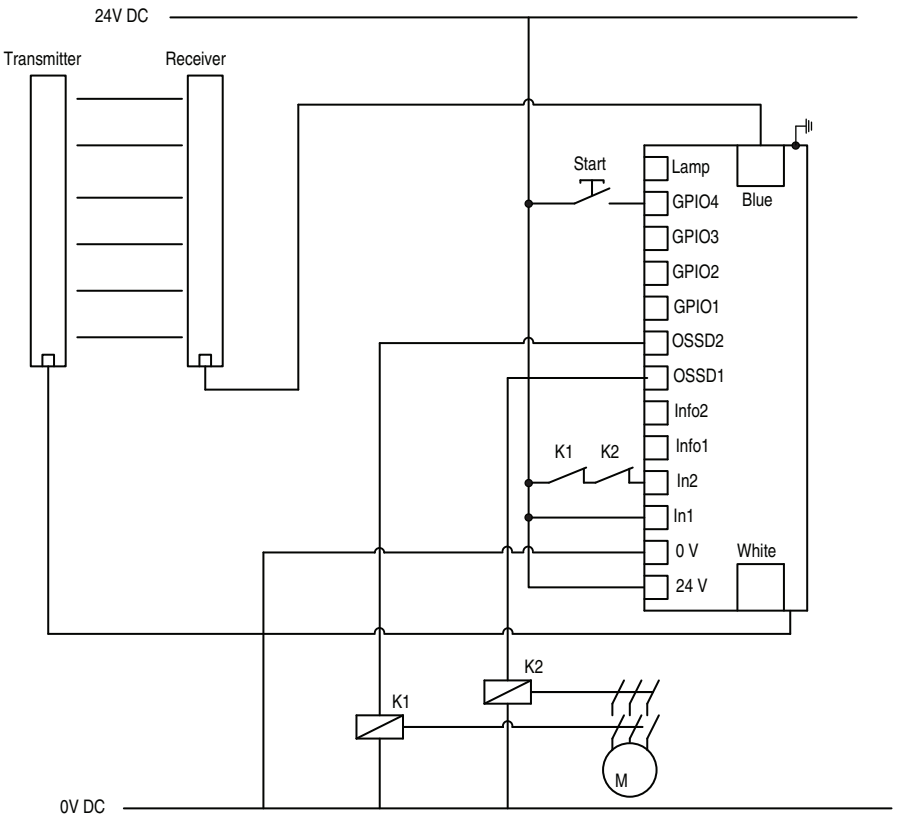


Figure 15: Wiring diagram for connection of MSR42 to contactors

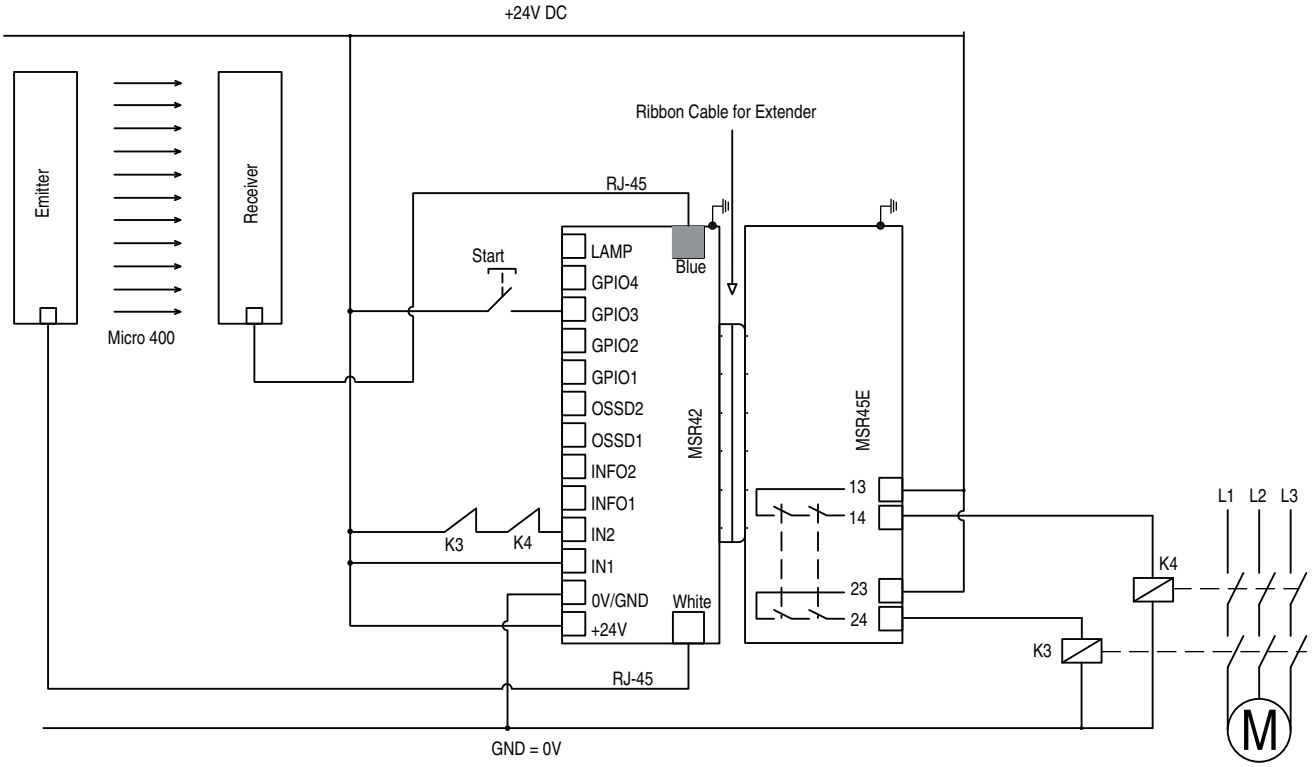


Figure 16: Wiring Diagram for connection to MSR45E Expansion Module and external contactor using start release

External test signal

In case the risk analysis of the application requires an external test signal (according to EN 13849-1) please refer to the user manual of the connected MSR42 control unit.

Power supply

The power supply and the evaluation of the protective field of a GuardShield Micro 400 light curtain can only be carried out through a MSR41 or MSR42 Series control unit.

Bringing into operation

The transmitter and receiver units must be connected to a MSR41 or MSR42 safety control unit. Then the supply voltage may be connected to the control unit. After power-up, there is an automatic self test (duration < 5 s) of all system components.

In case the protective field is free and the transmitter and receiver are correctly aligned, the green LEDs on the GuardShield Micro 400 light curtains will illuminate.

If after a successful power-up the light curtain detects an interruption of the protection field, the red LEDs on the GuardShield Micro 400 light curtains will illuminate.

Outputs

A GuardShield Micro 400 safety light curtain pair is always connected to a safety controller. Every connection to a machine controller or a safety circuit is done through an MSR41 or MSR42 safety controller, which provides two redundant semiconductor OSSD (Output Signal Switching Device) safety outputs. One or more MSR45E safety relay expansion modules can be connected to the MSR41 or MSR42 controller.

Each MSR41 or MSR42 safety controller also provides two status outputs (Info1 and Info2). These may only be connected to the machine controller for information purposes.

ATTENTION	The status outputs (Info1 and Info2) of the MSR41 or MSR42 safety control units are not safety related. They may not be used within the safety circuit of the machine.

ATTENTION	Prior to powering up the GuardShield Micro 400 system, the responsible person should review the following Checklist.

Checklist

Before the initiation of the GuardShield Micro 400 the responsible person should work through the following checklist.

Cable check prior to initiation:

1. The power supply is solely connected to the MSR41 or MSR42 safety controller.
2. The power supply is a 24V DC device, that must comply to all applicable standards of the Machinery Directive 2006/42/EC, and the product standard (IEC 61496).
3. Proper polarity of the power supply at the controller of the GuardShield Micro 400.
4. The transmitter connection cable is properly connected to the transmitter, the receiver connection cable is properly connected to the receiver. All plugs are connected.
5. The OSSD outputs are not connected to +24V DC.
6. The connected switching elements (load) are not connected to 24V DC.
7. No connection to a conventional power supply.
8. If two or more GuardShield Micro 400s are to be used, make sure that each system is properly installed, in order to avoid optical interference.

Switch the GuardShield Micro 400 on and check its function by observing the following: two seconds after switching on, the system starts to work properly if the protection field is free of obstructions

Troubleshooting

With the help of two LEDs, system conditions and faults of the GuardShield Micro 400 systems are indicated.

A red and a green LED are integrated in the end-cap connection module of each profile (near the cable), which clearly signals the status of the protective field. With the help of the LED display, system conditions and faults of the GuardShield Micro 400 systems are indicated.

Figure 17: Indicators

LED	Color	Meaning
Green	On	Protective field free
	Flashing	Intensity inadequate
Red	Off	Protective field free
	On	Light curtain interrupted
	Flashing	Error (lock out condition)

Table 7: LED meanings

The conditions signaled by the LEDs can also be obtained from the status outputs of the connected MSR41 or MSR42 Series safety control module (see user manual of the corresponding control unit).

Red LED continuously shining:

Check the alignment if the LED of the GuardShield Micro 400 is continuously red. With the help of the optical interface (445L-AF6150) it is possible to display individual beam status at a Laptop per USB interface.

Red LED blinking (lock-out condition):

If the red LED of the GuardShield Micro 400 is blinking, the following conditions can cause the fault:

1. Inadequate supply voltage to the MSR41 or MSR42 safety controller.
2. Transmitter and/or receiver cables not correctly plugged into the MSR41 or MSR42 controller.
3. Transmitter and receiver light curtains are connected to the incorrect locations in the controller (transmitter plugged into receiver connection).
4. Incorrect assembly in case of cascaded systems (transmitter and receiver mixed).
5. Cable connector makes poor contact.
6. Error in the EDM feedback channel at the safety control (only in case of EDM).
7. Short circuit at the OSSD outputs.
8. Foreign light source affecting the receiving unit.
9. Blanking configured and wrong light curtain length or resolution connected (only in case of blanking).

Corrective steps

1. Examine connections, cables and plugs of transmitter and receiver.
2. Turn the supply voltage off and on again.

With the help of the optical interface, it is possible to display the lock out information at a Laptop per USB interface.

If the LED of the safety light curtain is still blinking red, please contact Rockwell Automation technical support.

Note: In cascaded systems only the LED in the first safety light curtain will illuminate (closest to the safety controller).

Safety Instructions—Maintenance

ATTENTION	Never operate the GuardShield Micro 400 before carrying out the following inspection. Improper inspection may lead to operator injury.

For safety reasons all inspection results should be recorded.

Only persons, who clearly understand the functioning of the GuardShield Micro 400 and of the machine, may carry out an inspection.

If installer, planning engineer and operator are different people, make sure that the user has sufficient information available to carry out the inspection.

Daily Inspection

1. Approach to hazardous machine parts must only be possible through the protective field of GuardShield Micro 400.
2. Operators cannot step through the sensing area while working on dangerous machine parts.
3. The safety distance of the application is bigger than the calculated value.
4. The optic front cover is neither scratched nor dirty.

Operate the machine and check, if the hazardous movement will stop under the following circumstances.

5. The protective field is interrupted.
6. Hazardous machine movement stops immediately, if the protective field is interrupted by the test rod directly in front of the transmitter, directly in front of the receiver and in the middle between transmitter and receiver.
7. No hazardous machine movement while the test rod is anywhere within the protective field.
8. The power supply of the controller of the GuardShield Micro 400 is turned off.
9. If the blanking function is activated, check all sections of the protective field with the appropriate test piece.

IMPORTANT	If any of the above conditions do not result in the hazardous motion of the machine ceasing, do not allow the protected machine to be placed in operation.

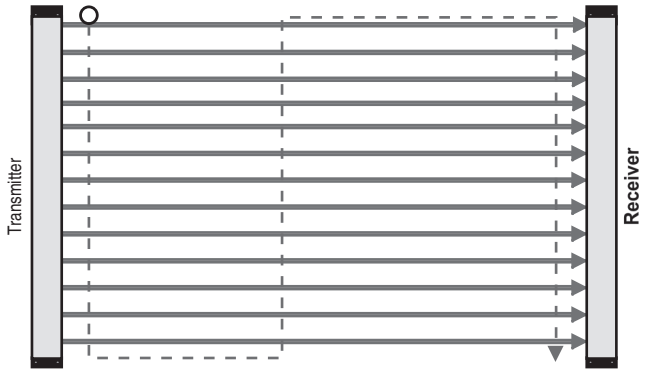


Figure 18: Proper testing of protective field using test rod

Six-Month Inspection

Check the following items every six months or whenever a machine setting was changed.

1. Machine stops or does not obstruct any safety function.
2. The latest machine or connection modifications have no effect on the control system.
3. The outputs of the controller of the GuardShield Micro 400 are properly connected to the machine.
4. The total response time of the machine is shorter than the calculated value.
5. Cables and plugs of the GuardShield Micro 400 are in good condition.
6. Mounting brackets, caps and cables are properly secured.

Cleaning

If the optic front cover of the GuardShield Micro 400 is dirty or scratched, the outputs turn off. Take a clean, soft cloth and rub without pressure. Do not apply aggressive, abrasive or scratching cleansing agents, which might attack the surface.

Product Label

Figure 19

Date Code

AABCCDEE

AA = Production place (AL=Mexico, 3T= Switzerland)

B = Year

CC = Day (LA = 001, LB = 002, ...)

D = Internal RA product code

- 4 = GS Safe 4 System
- 5 = GS Safe 4 Tx
- 6 = GS Safe 4 Rx

EE = Counter (AA=001, AB=002, ...)

Example: 3T8LA5AA:

AA = 3T = Produced in Switzerland

B = 8 = Year 2008

CC = LA = Day 001

D = 5 = Transmitter

EE = AA = 001

Explanation of terminology

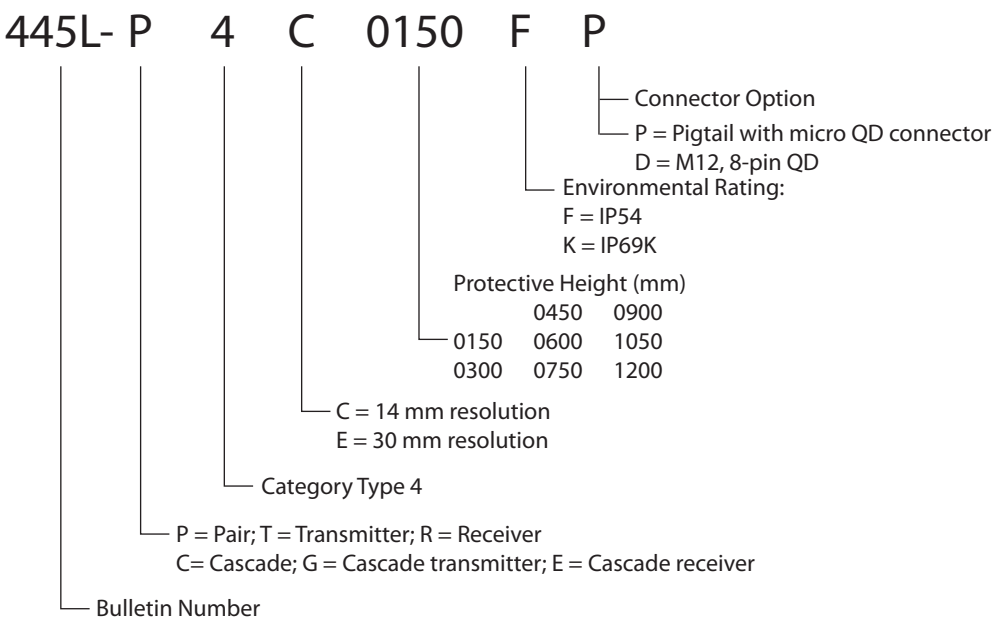
Rx	Receiver
Tx	Emitter
Cat No	Catalog Number
Ser	Series number
Rev	Revision number
HW	Hardware version
AOPD Type	Active optoelectronic protective equipment type 4 based on IEC 61496-1, -2
Type 4	type 4 based on IEC 61496-1, -2
3T8LA5AA	Date Code
Operating range	Maximum operating range
Protective height	Protective height
Resolution	Resolution for the protective device ("without blanking")
Enclosure Rating	IP – enclosure rating
Response time (no blanking)	Response time (see MSR42) for the protective device. See Response Time on page 7. 19 ms Response time t_{LC} of the light curtain cascade t_c Response time of the control unit including any connected relay modules t_N Sum of response times t_{LC} of all additional connected GuardShield Micro 400 light curtain cascades

Table 8

Technical Specifications

Safety Ratings	
Standards	IEC/EN61496 Parts 1 and 2, UL61496 Parts 1 and 2, UL1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849-1
Probability of a dangerous failure per hour PFH	6.0 E-9 1/h MSR42 or MSR41 and MSR45E 4.0 E-9 1/h Micro 400
Certifications	cULus Listed, TÜV, CE Marked for all applicable directives
Outputs	
Micro 400 Outputs	Data output to controller (MSR41 or MSR42)
MSR41/MSR42 Outputs	Two 400 mA OSSD
Non-Safety Outputs	Auxiliary outputs from MSR41 or MSR42 controller—2 configurable 100 mA, outputs
Switching Current @ Voltage, Max.	400 mA @ 24V DC
Operating Characteristics	
Response Time	14 mm: 12…42 ms, varies by protective height and resolution, protect. height 150-1200 mm 30 mm; 11…23 ms, varies by protective height and resolution, protect. height 150-1200 mm
Indicator LEDs	ON -State, OFF-State, Intensity, Lockout
Protected Height [mm (in.)]	150…1200 (5.9 …47.2) in 150 mm increments
Resolution [mm (in.)]	14 (0.55), 30 (1.18) or PAC (Perimeter)
Scanning Range/Resolution	14 mm (0.55 in.) resolution: 0…5 m (16.4 ft) 30 mm (1.18 in.) resolution: 0…5 m (16.4 ft)
Synchronization	Electrical through MSR41 or MSR42
Wave length	940 nm
Time for self check when switching on U_{sp}	< 5 s
Environmental	
Enclosure Type Rating	Micro 400 is IP54; Micro 400 IP69K is IP65, IP66, IP67, IP68, IP69K, Plug: IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature	0…55 °C (14…131 °F)
Storage Temperature	-20…70 °C (4…158 °F)
Vibration	IEC 60068-2-6; Frequency 10…55 Hz; Amplitude 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29; Acceleration 10 g, pulse duration 16 ms 10…55 Hz; Amplitude 0.35 mm (0.01 in.)
Power Supply	Input power from MSR41 or MSR42 controller
Input Power, Max.	24V DC ±15% (MSR41 or MSR42 controller)
Maximum Residual Ripple	5% of Vss
Power Consumption	0.07 A max. (no load)
Equipment Class	III (VDE 0106 part 100)
EMC	IEC 61496 part 1
Physical Characteristics	
Max. number of beams	255
Standard mounting	180° adjustable mounting brackets supplied (two sets 445L-AF6143)
Weight	Varies by protective height
Housing Cross Section	15 mm x 20 mm (0.59…0.79 in.) profile slim (40 mm x 40 mm (1.18.1.57 in.) profile reinforced)
Optical window	Polycarbonate
Enclosure treatment	Polyester powder coated, silicon free
Connection Type	Transmitter/receiver: 8-pin M12 micro QD
Cable Length	1, 2, 3, 5, and 8 m (3.3, 6.6, 9.8, 16.4, and 26.2 ft) cable M12 to RJ45 for MSR41 or MSR42. Max. total system length can not exceed 10 m (32.8 ft).
Patchcords	1, 3 and 5 m (3.3, 9.8 and 16.4ft) M12 to M12 patchcords. Total system length cannot exceed 10 m (32.8 ft) including protective height of Micro 400, integrated cables and patchcords from M12 connector to MSR41 or MSR42.

Catalog Number Configurator


445L- P 4 C 0150 F P
Connector Option
P = Pigtail with micro QD connector
D = M12, 8-pin QD
Environmental Rating:
F = IP54
K = IP69K
Protective Height (mm)
0450 0900
0150 0600 1050
0300 0750 1200
C = 14 mm resolution
E = 30 mm resolution
Category Type 4
P = Pair; T = Transmitter; R = Receiver
C= Cascade; G = Cascade transmitter; E = Cascade receiver
Bulletin Number

GuardShield Micro 400 Products

The response times (*) are maximum values with no blanking configured. If blanking is configured in the Micro 400 controller, the response time values could be higher. The times depend on the controller type and the configuration. The real response time may be faster. Please obtain the exact time from the software "Configuration Tool."

GuardShield Micro 400, Standard, Profile 20 x 15 mm, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [ind. packaging]
445L-P4C0150FP	445L-T4C0150FP	445L-R4C0150FP	14 (0.55)	150	14.6 ms	0.8 kg
445L-P4C0300FP	445L-T4C0300FP	445L-R4C0300FP	14 (0.55)	300	18.5 ms	0.9 kg
445L-P4C0450FP	445L-T4C0450FP	445L-R4C0450FP	14 (0.55)	450	22.4 ms	0.9 kg
445L-P4C0600FP	445L-T4C0600FP	445L-R4C0600FP	14 (0.55)	600	26.3 ms	1.0 kg
445L-P4C0750FP	445L-T4C0750FP	445L-R4C0750FP	14 (0.55)	750	30.2 ms	1.1 kg
445L-P4C0900FP	445L-T4C0900FP	445L-R4C0900FP	14 (0.55)	900	34.1 ms	1.3 kg
445L-P4C1050FP	445L-T4C1050FP	445L-R4C1050FP	14 (0.55)	1050	38.0 ms	1.3 kg
445L-P4C1200FP	445L-T4C1200FP	445L-R4C1200FP	14 (0.55)	1200	41.9 ms	1.3 kg

GuardShield Micro 400, Standard, Profile 20 x 15 mm, Resolution 30 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [ind. packaging]
445L-P4E0150FP	445L-T4E0150FP	445L-R4E0150FP	30 mm (1.18)	150	12.4 ms	0.8 kg
445L-P4E0300FP	445L-T4E0300FP	445L-R4E0300FP	30 mm (1.18)	300	13.9 ms	0.9 kg
445L-P4E0450FP	445L-T4E0450FP	445L-R4E0450FP	30 mm (1.18)	450	15.5 ms	0.9 kg
445L-P4E0600FP	445L-T4E0600FP	445L-R4E0600FP	30 mm (1.18)	600	17.0 ms	1.0 kg
445L-P4E0750FP	445L-T4E0750FP	445L-R4E0750FP	30 mm (1.18)	750	18.5 ms	1.1 kg
445L-P4E0900FP	445L-T4E0900FP	445L-R4E0900FP	30 mm (1.18)	900	20.2 ms	1.2 kg
445L-P4E1050FP	445L-T4E1050FP	445L-R4E1050FP	30 mm (1.18)	1050	21.7 ms	1.3 kg
445L-P4E1200FP	445L-T4E1200FP	445L-R4E1200FP	30 mm (1.18)	1200	23.3 ms	1.3 kg

GuardShield Micro 400, Cascaded, Profile 20 x 15 mm, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [ind. packaging]
445L-C4C0150FP	445L-G4C0150FP	445L-F4C0150FP	14 (0.55)	150	14.6 ms	0.8 kg
445L-C4C0300FP	445L-G4C0300FP	445L-F4C0300FP	14 (0.55)	300	18.5 ms	0.9 kg
445L-C4C0450FP	445L-G4C0450FP	445L-F4C0450FP	14 (0.55)	450	22.4 ms	0.9 kg
445L-C4C0600FP	445L-G4C0600FP	445L-F4C0600FP	14 (0.55)	600	26.3 ms	1.0 kg
445L-C4C0900FP	445L-G4C0900FP	445L-F4C0900FP	14 (0.55)	900	34.1 ms	1.2 kg
445L-C4C1200FP	445L-G4C1200FP	445L-F4C1200FP	14 (0.55)	1200	41.9 ms	1.3 kg

GuardShield Micro 400, Cascaded, Profile 20 x 15 mm, Resolution 30 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [ind. packaging]
445L-C4E0150FP	445L-G4E0150FP	445L-F4E0150FP	30 (1.18)	150 mm	12.4 ms	0.8 kg
445L-C4E0300FP	445L-G4E0300FP	445L-F4E0300FP	30 (1.18)	300 mm	13.9 ms	0.9 kg
445L-C4E0600FP	445L-G4E0600FP	445L-F4E0600FP	30 (1.18)	600 mm	17.0 ms	1.0 kg
445L-C4E0750FP	445L-G4E0750FP	445L-F4E0750FP	30 (1.18)	750 mm	18.5 ms	1.1 kg
445L-C4E0900FP	445L-G4E0900FP	445L-F4E0900FP	30 (1.18)	900 mm	20.2 ms	1.2 kg
445L-C4E1200FP	445L-G4E1200FP	445L-F4E1200FP	30 (1.18)	1200 mm	23.3 ms	1.3 kg

GuardShield Micro 400, IP69K, tube, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [ind. packaging]
445L-P4C0300KD	445L-T4C0300KD	445L-R4C0300KD	14 (0.55)	300	18.5 ms	0.7 kg
445L-P4C0600KD	445L-T4C0600KD	445L-R4C0600KD	14 (0.55)	600	26.3 ms	0.9 kg
445L-P4C0900KD	445L-T4C0900KD	445L-R4C0900KD	14 (0.55)	900	34.1 ms	1.1 kg
445L-P4C1200KD	445L-T4C1200KD	445L-R4C1200KD	14 (0.55)	1200	41.9 ms	1.3 kg

Dimensions [mm (in.)]

GuardShield Micro 400 Standard

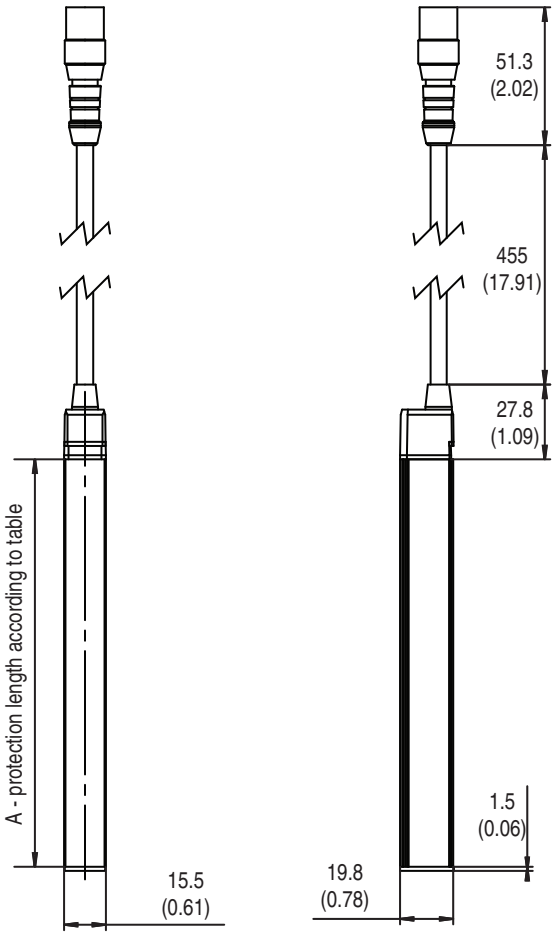


Figure 20: GuardShield Micro 400

GuardShield Micro 400 Cascades

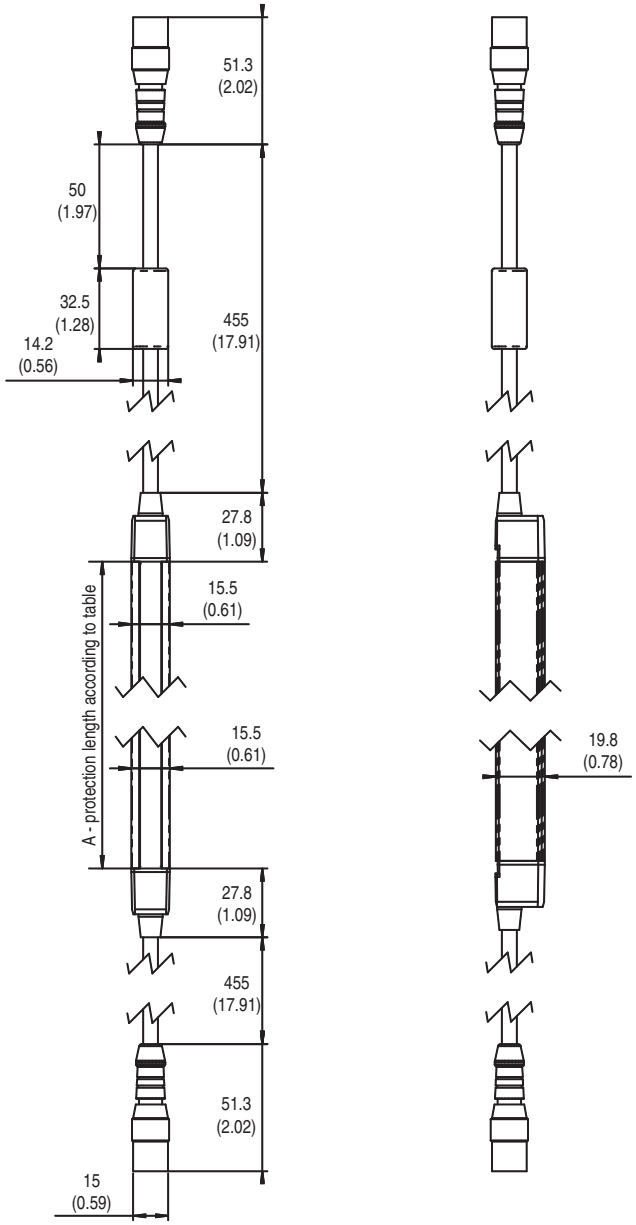


Figure 21: GuardShield cascadable Micro 400

GuardShield Micro 400 IP69K (Washdown)

System Cat No. (incl. Mounting kit)	Protection zone height A mm (inch)	System Length B [mm]
445L-P4C0300KD	300 (11.8)	374
445L-P4C0600KD	600 (23.6)	674
445L-P4C0900KD	900 (35.4)	974
445L-P4C1200KD	1200 (47.2)	1274

Table 9

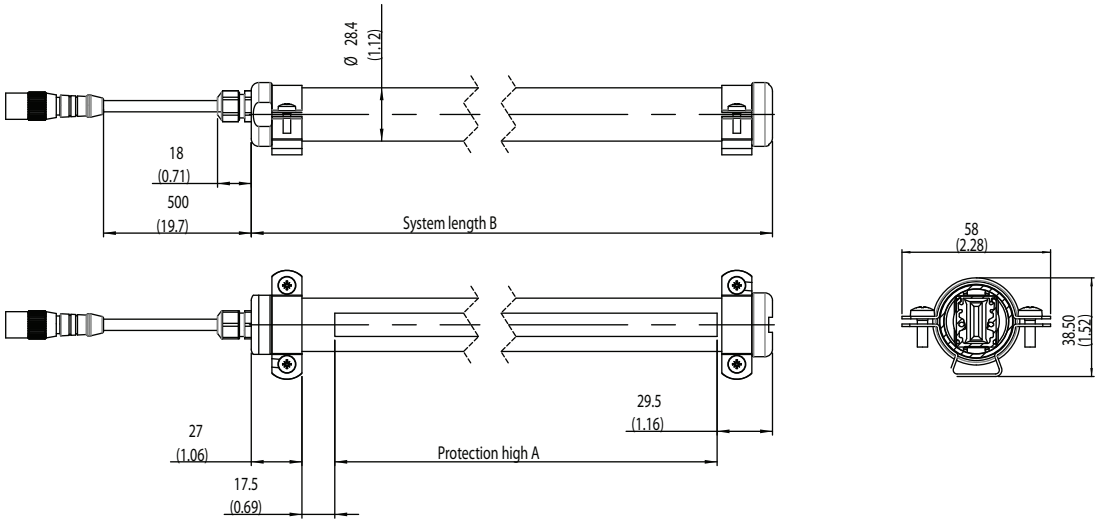


Figure 22

Accessories

Required Safety Controller — Select One

Description	Mounting	Size	Cat. No.
MSR41 ON/OFF	35 mm DIN Rail	22.5 mm	440R-P221AGS
MSR42 Multi-functional module	35 mm DIN Rail	22.5 mm	440R-P226AGS-NNR

Allen-Bradley
Guardmaster®

Optional Safety Relay Expansion Module

Relay	Input Voltage	Reset	Outputs	Cat.No.
MSR45E Safety Relay Expansion Module	Supplied by MSR41 or MSR42	Determined by MSR41 or MSR42	2 N.O.	440-P4NANS

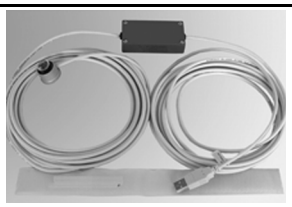
Safety Relay Interface accessories for MSR41 or MSR42 Controllers

The MSR41 or MSR42 can have up to three MSR45E safety relays interconnected. Each module requires a ribbon cable connector to make the interconnection. The table shows the cat. no. for each ribbon cable connector.

Description		Cat. No.
	Ribbon cable – for one MSR45E	440R-ACABL1
	Ribbon cable – for two MSR45Es	440R-ACABL2
	Ribbon cable – for three MSR45Es	440R-ACABL3

Optical interface

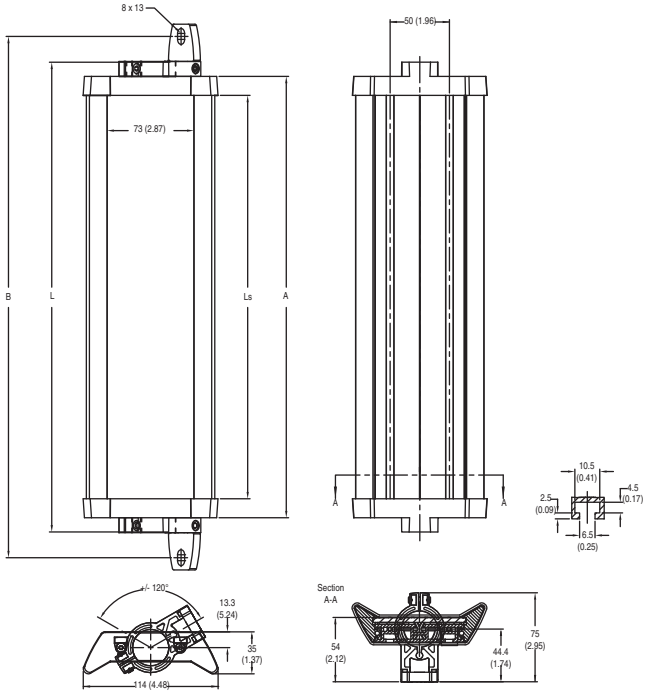
Operation mode and parameters of the MSR42 controller may be changed using the configuration software which is available on www.ab.com and with the optical interface 445L-AF6150. Programming of the MSR42 is only necessary for advanced operating modes (e.g. blanking, muting, etc.) or for connection of additional devices (e.g., enabling switch, emergency stop button, etc.).

Description		Cat. No.
	USB optical interface software configuration tool used to configure the MSR42	445L-AF6150

Optional accessories:

Description		Cat. No.
	Adjustable 180° bracket kit (two per kit) supplied with each pair	445L-AF6143
	Flat bracket kit (two per kit) Two kits required per pair	445L-AF6145
	Adjustable flat bracket (two per kit) Two kits required per pair	445L-AF6149
	IP69K mounting bracket kit (two kits per pair supplied with each IP69K pair)	445L-AF6160

Mirror 440L-AM075



Model No.	Series	Description	L	Ls	A	B
440L-AM0750300	A	Mirror, 300 mm, 4 m	396	340	372	440
440L-AM0750450	A	Mirror, 450 mm, 4 m	546	490	522	590
440L-AM0750600	A	Mirror, 600 mm, 4 m	696	640	672	740
440L-AM0750750	A	Mirror, 750 mm, 4 m	846	790	822	890
440L-AM0750900	A	Mirror, 900 mm, 4 m	996	940	972	1040
440L-AM0751050	A	Mirror, 1050 mm, 4 m	1146	1090	1122	1190
440L-AM0751200	A	Mirror, 1200 mm, 4 m	1296	1240	1272	1340
440L-AM0751350	A	Mirror, 1350 mm, 4 m	1446	1390	1422	1490
440L-AM0751500	A	Mirror, 1500 mm, 4 m	1596	1540	1572	1640
440L-AM0751650	A	Mirror, 1650 mm, 4 m	1746	1690	1722	1790
440L-AM0751800	A	Mirror, 1800 mm, 4 m	1896	1840	1872	1940

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by 10% per mirror. Each corner mirror supplied with two end-cap mounting brackets:

Protected Height [mm (in.)]	Narrow Mirror Short-Range 0…4 m (0…13.1ft)	Mirror height [(mm (in.)]	Cat. No.
150 (5.9) / 300 (11.8)		300 (11.8)	440L-AM0750300
450 (17.7)		450 (17.7)	440L-AM0750450
600 (23.6)		600 (23.6)	440L-AM0750600
750 (29.5)		750 (29.5)	440L-AM0750750
900 (35.4)		900 (35.4)	440L-AM0750900
1050 (41.3)		1050 (41.3	440L-AM0751050
1200 (47.2)		1200 (47.2)	440L-AM0751200

Table 10

Appendix

GuardShield Micro 400 Special Safety Light Curtain Systems

Content

Introduction
Systems with reinforced profiles
Perimeter Systems
Special patchcords
Special systems

In addition to the GuardShield Micro 400 manual this appendix gives some additional information for some GuardShield Micro 400 special systems.

Systems with Re-inforced Profiles

The GuardShield Micro 400 standard safety light curtains are usually offered in the slim profile with dimensions of 20 x 15 mm. The maximum length is limited to 1200 mm (47.2 in.) to prevent a damage by twisting or bending. For longer lengths up to 2200 mm the systems are offered in a re-inforced profile. Standard and cascaded systems are available based on the re-inforced profile.

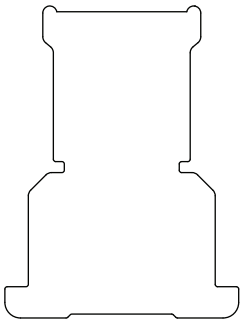


Figure 23: Cross section of the re-inforced profile

European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger. This safety distance ensures that the point of danger can only be reached after the dangerous state of the machine has been completely removed.

The safety distance as defined in EN ISO 13855 and EN ISO 13857 depends on:

- Stopping/run-down time of the machine or system. (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the protective device, e.g. GuardShield Safe 4 (for "Response Time" see page 7).
- Reach or approach speed.
- Resolution of the light curtain and/or beam separation.

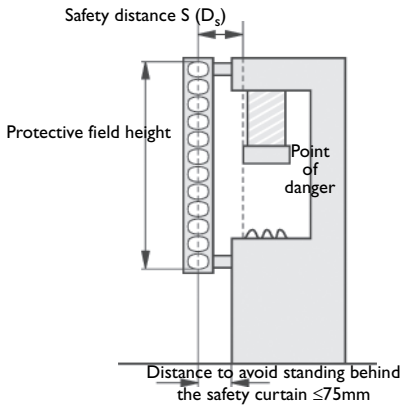

Safety distance S (Ds)
Protective field height
Point of danger
Distance to avoid standing behind the safety curtain ≤75mm

Figure 3: Safety distance from the point of danger

How to Calculate the Safety Distance S for GuardShield Safe 4 PAC Systems

In the case of perimeter systems or light curtains with a resolution d > 40 mm, the safety distance is calculated for vertical mounting light curtains and horizontal approach, according to the formula:

S = 1.6 mm/ms x T + 850 mm

More detailed information regarding safety distance and safety heights can be found in standard EN 13855 (2010).

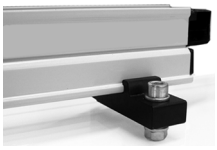
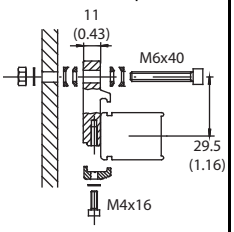
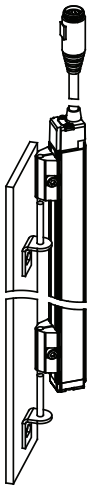
	Flat bracket kit for reinforce profile. (Two per kit) supplied with each pair  Two kits required per pair.	445L-AF6140
	Adjustable 180° bracket kit (two per kit) for reinforced profile.  Two kits required per pair.	445L-AF6141

Figure 24: Mounting brackets for reinforced profile

Perimeter Systems (PAC)

Perimeter systems are usually produced by means of several single beam light barriers. But the flexibility of the GuardShield Micro 400 system allows also the production of vertical entry safeguarding according to the standard EN ISO 13855 [2010]. Such systems are composed of active and passive elements in one compact profile. The element length of each is 50 mm (variations are given in the appendix).

The big advantage of GuardShield Micro 400 Perimeter systems is the easier way of mounting and the uncomplicated way of starting up the operation. The time needed to connect the wires and aligning the optics is reduced in comparison to standard perimeter systems consisting of single beam light barriers, where often mirrors are also included which can only be positioned with difficulties.

The protective field and the active elements, respectively, are clearly recognized as surfaces with the integrated optical lenses. The not monitored areas (passive elements) are also clearly indicated as yellow surfaces.

Special Patchcords

All GuardShield Micro 400 light curtains have actually M12/8-pin connector. Special patchcords might be necessary to replace older connector versions:

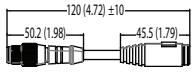
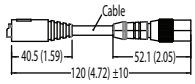
	445L-AC8CPx	Patchcord, 8 Pin, 1 m, M12 to M12 (x = 1, 3 or 5 meter)
	445L-ACDN9M12	Patchcord, 8 Pin, Din9/female to M12/ male
	445L-109296	Patchcord, 8 Pin, Din9/male to M12/ female

Table 11:

Special Systems

Besides the standard lengths given in "Technical Specifications" on page 20 Rockwell Automation also offers some special lengths and configurations. For those systems, longer lead time might be expected.

The mentioned response times (*) are maximum values. The times depend on the controller type and the configuration. The real response time may be faster. Please obtain the exact response time from the MSR42 "Configuration software."

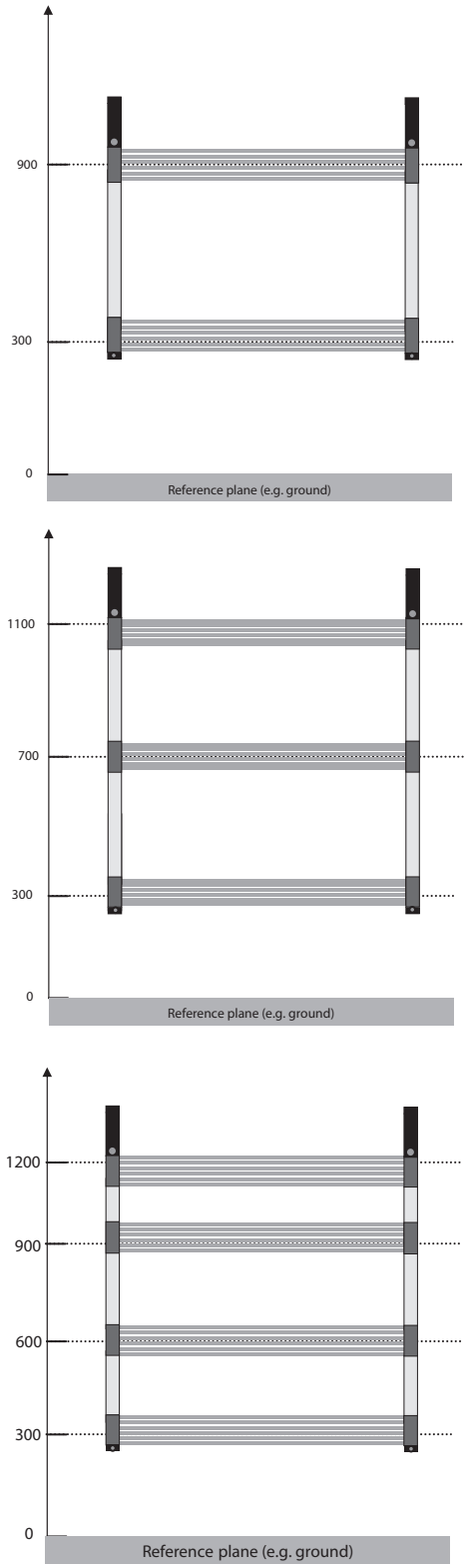


Figure 25: Perimeter systems (2-, 3- and 4-beams), according to EN ISO 13855 [2010]

GuardShield Micro 400, Nonstandard, Profile 20 x 15 mm, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-P4C0050FP	445L-T4C0050FP	445L-R4C0050FP	14 (0.55)	20x15	50	12.0 ms	0.6 kg
445L-P4C0100FP	445L-T4C0100FP	445L-R4C0100FP	14 (0.55)	20x15	100	13.3 ms	0.7 kg
445L-P4C0200FP	445L-T4C0200FP	445L-R4C0200FP	14 (0.55)	20x15	200	15.9 ms	0.8 kg
445L-P4C0250FP	445L-T4C0250FP	445L-R4C0250FP	14 (0.55)	20x15	250	17.2 ms	0.8 kg
445L-P4C0350FP	445L-T4C0350FP	445L-R4C0350FP	14 (0.55)	20x15	350	19.8 ms	0.9 kg
445L-P4C0400FP	445L-T4C0400FP	445L-R4C0400FP	14 (0.55)	20x15	400	21.1 ms	0.9 kg
445L-P4C0500FP	445L-T4C0500FP	445L-R4C0500FP	14 (0.55)	20x15	500	23.7 ms	0.9 kg
445L-P4C0550FP	445L-T4C0550FP	445L-R4C0550FP	14 (0.55)	20x15	550	25.0 ms	1.0 kg
445L-P4C0650FP	445L-T4C0650FP	445L-R4C0650FP	14 (0.55)	20x15	650	27.6 ms	1.0 kg
445L-P4C0700FP	445L-T4C0700FP	445L-R4C0700FP	14 (0.55)	20x15	700	28.9 ms	1.1 kg
445L-P4C0800FP	445L-T4C0800FP	445L-R4C0800FP	14 (0.55)	20x15	800	31.5 ms	1.2 kg
445L-P4C0850FP	445L-T4C0850FP	445L-R4C0850FP	14 (0.55)	20x15	850	32.8 ms	1.2 kg
445L-P4C1000FP	445L-T4C1000FP	445L-R4C1000FP	14 (0.55)	20x15	1000	36.7 ms	1.3 kg
445L-P4C1100FP	445L-T4C1100FP	445L-R4C1100FP	14 (0.55)	20x15	1100	39.3 ms	1.3 kg

GuardShield Micro 400, Nonstandard, Profile 20 x 15 mm, Resolution 30 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-P4E0050FP	445L-T4E0050FP	445L-R4E0050FP	30 mm (1.18)	20x15	50	11.3 ms	0.6 kg
445L-P4E0500FP	445L-T4E0500FP	445L-R4E0500FP	30 mm (1.18)	20x15	500	15.9 ms	0.9 kg
445L-P4E0550FP	445L-T4E0550FP	445L-R4E0550FP	30 mm (1.18)	20x15	550	16.5 ms	1.0 kg

GuardShield Micro 400, Nonstandard, Cascaded, Profile 20 x 15 mm, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-C4C0050FP	445L-G4C0050FP	445L-F4C0050FP	14 (0.55)	20x15	50	12.0 ms	0.6 kg
445L-C4C0250FP	445L-G4C0250FP	445L-F4C0250FP	14 (0.55)	20x15	250	17.2 ms	0.9 kg
445L-C4C0450FP	445L-G4C0450FP	445L-F4C0450FP	14 (0.55)	20x15	450	22.4 ms	0.9 kg
445L-C4C0500FP	445L-G4C0500FP	445L-F4C0500FP	14 (0.55)	20x15	500	23.7 ms	0.9 kg
445L-C4C0550FP	445L-G4C0550FP	445L-F4C0550FP	14 (0.55)	20x15	550	25.0 ms	1.0 kg
445L-C4C0650FP	445L-G4C0650FP	445L-F4C0650FP	14 (0.55)	20x15	650	27.6 ms	1.0 kg
445L-C4C0700FP	445L-G4C0700FP	445L-F4C0700FP	14 (0.55)	20x15	700	28.9 ms	1.0 kg
445L-C4C0800FP	445L-G4C0800FP	445L-F4C0800FP	14 (0.55)	20x15	800	31.5 ms	1.1 kg
445L-C4C1000FP	445L-G4C1000FP	445L-F4C1000FP	14 (0.55)	20x15	1000	36.7 ms	1.3 kg

GuardShield Micro 400, Nonstandard, Cascaded, Profile 20x15mm, Resolution 30 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-C4E0750FP	445L-G4E0750FP	445L-F4E0750FP	30 (1.18)	20x15	750 mm	18.5 ms	1.1 kg

GuardShield Micro 400, Special Systems, Profile Reinforced, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-110490-0001	445L-110119	445L-110118	14 (0.55)	40x30	150	14.6 ms	1.1 kg
445L-110490-0002	445L-110121	445L-110120	14 (0.55)	40x30	300	18.5 ms	1.3 kg
445L-110490-0003	445L-110123	445L-110122	14 (0.55)	40x30	400	21.1 ms	1.5 kg
445L-110490-0004	445L-110125	445L-110124	14 (0.55)	40x30	450	22.4 ms	1.6 kg
445L-110490-0006	445L-110129	445L-110128	14 (0.55)	40x30	600	26.3 ms	1.9 kg
445L-110490-0008	445L-110133	445L-110132	14 (0.55)	40x30	750	30.2 ms	2.2 kg
445L-110490-0009	445L-110135	445L-110134	14 (0.55)	40x30	900	34.1 ms	2.5 kg
445L-110490-0010	445L-110137	445L-110136	14 (0.55)	40x30	1000	36.7 ms	2.8 kg
445L-110490-0011	445L-110139	445L-110138	14 (0.55)	40x30	1200	41.9 ms	3.1 kg
445L-110490-0013	445L-110143	445L-110142	14 (0.55)	40x30	1350	45.8 ms	3.4 kg
445L-110490-0014	445L-110145	445L-110144	14 (0.55)	40x30	1500	49.7 ms	3.7 kg
445L-110490-0015	445L-110147	445L-110146	14 (0.55)	40x30	1600	52.3 ms	4.1 kg
445L-110490-0017	445L-110151	445L-110150	14 (0.55)	40x30	1650	53.6 ms	4.1 kg
445L-110490-0018	445L-110153	445L-110152	14 (0.55)	40x30	1800	57.5 ms	4.3 kg
445L-110490-0019	445L-110155	445L-110154	14 (0.55)	40x30	2000	62.7 ms	8.6 kg
445L-110490-0020	445L-110157	445L-110156	14 (0.55)	40x30	2200	67.9 ms	8.9 kg

GuardShield Micro 400, Special Systems, Profile Reinforced, Resolution 30 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-110490-0005	445L-110127	445L-110126	30 (1.18)	40x30	500	15.9 ms	1.7 kg
445L-110490-0012	445L-110141	445L-110140	30 (1.18)	40x30	1300	24.3 ms	3.3 kg
445L-110490-0016	445L-110149	445L-110148	30 (1.18)	40x30	1600	27.4 ms	4.1 kg

GuardShield Micro 400, Special Systems, Cascaded, Profile Reinforced, Resolution 14 mm

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-110491-0001	445L-110171	445L-110170	14 (0.55)	40x30	600	26.3 ms	1.9 kg
445L-110491-0002	445L-110173	445L-110172	14 (0.55)	40x30	750	30.2 ms	2.2 kg
445L-110491-0003	445L-110175	445L-110174	14 (0.55)	40x30	900	34.1 ms	2.5 kg
445L-110491-0004	445L-110177	445L-110176	14 (0.55)	40x30	1000	36.7 ms	2.8 kg
445L-110491-0005	445L-110179	445L-110178	14 (0.55)	40x30	1100	39.3 ms	2.9 kg
445L-110491-0006	445L-110181	445L-110180	14 (0.55)	40x30	1200	41.9 ms	3.1 kg
445L-110491-0007	445L-110183	445L-110182	14 (0.55)	40x30	1350	45.8 ms	3.4 kg
445L-110491-0008	445L-110185	445L-110184	14 (0.55)	40x30	1500	49.7 ms	3.7 kg
445L-110491-0009	445L-110187	445L-110186	14 (0.55)	40x30	1650	53.6 ms	4.1 kg
445L-110491-0010	445L-110189	445L-110188	14 (0.55)	40x30	1800	57.5 ms	4.3 kg

GuardShield Micro 400, Special Systems, Profile Slim, PAC

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-110492-0002	445L-110161	445L-110160	2 Beam, 500 mm	20x15	550	11.8 ms	1.0 kg
445L-110492-0004	445L-110165	445L-110164	3 Beam, 400 mm	20x15	850	12.4 ms	1.2 kg
445L-110492-0006	445L-110169	445L-110168	4 Beam, 300 mm	20x15	1250	12.9 ms	1.3 kg

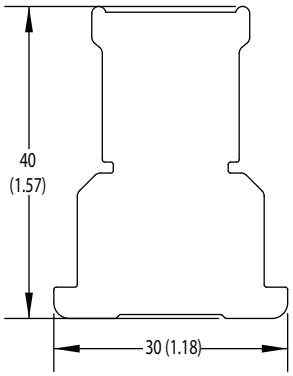
GuardShield Micro 400, Special Systems, Profile Reinforced, PAC

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-110492-0001	445L-110159	445L-110158	2 Beam, 500 mm	40x30	550	11.8 ms	1.8 kg
445L-110492-0003	445L-110163	445L-110162	3 Beam, 400 mm	40x30	850	12.4 ms	2.4 kg
445L-110492-0005	445L-110167	445L-110166	4 Beam, 300 mm	40x30	1250	12.9 ms	3.1 kg

Special GuardShield Micro 400, Special Systems

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Profile Dimensions [mm x mm]	Protection Height L [mm (in.)]	Max. response time t_{LC} (ms) *	Weight per pair [incl. packaging]
445L-103567-0055	-	-	14 (0.55)	20 x 15	150 - 150 mm	18.5 ms	1.9 kg
445L-109316	-	-	14 (0.55)	20 x 15	150 mm cascaded	14.6 ms	0.6 kg
445L-109317	-	-	14 (0.55)	20 x 15	150 mm	14. 6 ms	0.6 kg
445L-103567-0018	-	-	14 (0.55)	20 x 15	50 - 450 mm	23.7 ms	1.2 kg
445L-103567-0065	-	-	14 (0.55)	20 x 15	50 - 400 mm	22.4 ms	1.1 kg
445L-110490-0007	445L-110131	445L-110130	30 (1.18)	20 x 15	650	17.6 ms	1.0 kg
445L-108582-0002	445L-108578	445L-108579	30 (1.18)	20 x 15	900	20.2 ms	1.3 kg
-	445L-108670	445L-108671	30 (1.18)	20 x 15	800	19.1 ms	1.2 kg

Robust Profile Dimensions [mm (in.)]



Certificate

EC Declaration of Conformity

The undersigned, representing the manufacturer	*and the authorised representative established within the Community*
Rockwell Automation, Inc.	***Rockwell Automation BV***
2 Executive Dr.	***Rivium 1e Straat, 23***
Chelmsford, MA 01824	***2909 LE Capelle aan den IJssel***
USA	***Netherlands***
Herewith declare that the Products:	***GuardShield Micro400 Safety Light Curtains***
Product identification (brand and catalogue number/part number):	***Allen-Bradley / GuardShield 445L Series*** *(reference the attached list of catalogue numbers)*
Product Safety Function	***Micro400 safety light curtains are Type 4 active opto-electronic protective devices (AOPD) with resolutions of 14mm and 30mm. They are cascadeable, and can be used in conjunction with MSR4x safety devices up to Safety Category 4 (EN 954-1)/ SIL3/SIL CL3 (EN 61508 / EN 62061) and PL e (EN ISO 13849-1).***

are in conformity with the essential requirements of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

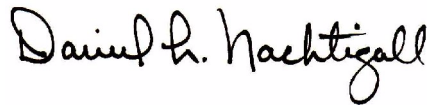
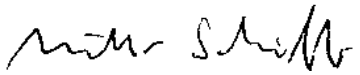
2006/42/EC	*Machinery Directive*
2004/108/EC	*EMC Directive*

and that the standards and/or technical specifications referenced below have been applied:

EN 61496-1:2004 + A1:2008	*Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests*
IEC 61496-2:2006	*Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPD's)*
EN ISO 13849-1:2008	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN 61508 Parts 1-7:1998-2000	*Functional safety of electrical/electronic/programmable electronic safety-related systems*
EN 954-1:1997	*Safety of machinery – Safety related parts of control systems – Part 1: General principles for design*
EN 50178:1997	*Electronic equipment for use in power installations*
EN 62061:2005	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN 60204-1:2006	*Safety of machinery – Electrical equipment of machines – General requirements*
EN 61000-6-4:2007	*Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (Class A)*
EN 61000-6-2:2005	*Electromagnetic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

Conformance of a type sample belonging to the above mentioned product family with the regulations from the EC Machinery Directive has been certified by:

TÜV Rheinland Product Safety GmbH	*EC Type Examination Certificate No:*
Am Grauen Stein	*968/M 205.00/08 & 968/M 205.00/09*
D-51105 Köln, Germany	

Manufacturer:	*Authorised Representative in the Community:*
	
Signature	***Signature***
Name: *Daniel L. Nachtigall*	*Name:* *Viktor Schiffer*
Position: *Supv – Product Certification Engineering*	*Position:* *Engineering Manager*
Date: *02-Mar-2011*	*Date:* *08-Mar-2011*

Document Control Number: SEN-0393-B-EN *1 / 3*

Catalogue number	*Series* [1]	*Description*
445L-x4xxFP		*GuardShield Micro400 safety light curtain per Nomenclature*

1) If no series number is given, then all series are covered

NOMENCLATURE:

Standard 445L Series Nomenclature:

445L	*-*	*C*	*4*	*C*	*1200*	*F*	*P*
1		*2*	*3*	*4*	*5*	*6*	*7*

1.	*Designates Product Line* *445L – GuardShield Micro 400 safety light curtain*		
2.	*Designates Optic Head Designation* *C – Cascadeable transmitter and receiver pair* *F – Cascadeable receiver* *G – Cascadeable transmitter* *P – Transmitter and receiver pair* *R – Receiver* *T – Transmitter*		
3.	*Designates AOPD Safety Type* *4 – Type 4*		
4.	*Designates Photoelectric Safety Device and Sensing Resolution* *C – GuardShield Micro400, 14 mm sensing* *E – GuardShield Micro400, 30 mm sensing*		
5.	*Designates Protective Height*		
	0050 – 050 mm *0100 – 100 mm* *0150 – 150 mm* *0200 – 200 mm* *0250 – 250 mm* *0300 – 300 mm* *0350 – 350 mm* *0400 – 400 mm* *0450 – 450 mm* *0500 – 500 mm*	*0550 – 550 mm* *0600 – 600 mm* *0650 – 650 mm* *0700 – 700 mm* *0750 – 750 mm* *0800 – 800 mm* *0850 – 850 mm* *0900 – 900 mm* *0950 – 950 mm* *1000 – 1000 mm*	*1050 – 1050 mm* *1100 – 1100 mm* *1150 – 1150 mm* *1200 – 1200 mm*
6.	*Designates Environmental Rating* *F – IP54* *K – IP69K*		
7	*Designates Connection Type* *P – Pigtail with micro-style quick disconnect, M12*		

Custom 445L Series Nomenclature (1):

445L	*-*	*110490-0000*
1		*2*

1.	*Designates Product Line* *445L – GuardShield Micro 400 safety light curtain*
2.	*Designates Custom Catalog Designation* *Any number from 100000-0000...199999-9999 can be used to denote custom catalog numbers for the 445L series light curtains*

Custom 445L Series Nomenclature (2):

445L	*-*	*105000*
1		*2*

1.	*Designates Product Line* *445L – GuardShield Micro 400 safety light curtain*
2.	*Designates Custom Catalog Designation* *Any number from 100000...199999 can be used to denote custom catalog numbers for the 445L series light curtains*

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Guardmaster is a registered trademark of Rockwell Automation, Inc.

www.rockwellautomation.com

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